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BROWN (J. G.). **An undescribed fungus on the Pepper tree.**—Abs. in *Science*, N.S. lv, p. 547, 1922.

The pepper tree (*Schinus molle*), which is grown as an ornamental tree in warmer areas in the south-western United States, was found attacked by a fungus causing rotting of the wood. The branches may die gradually, or the entire tree may wilt and die suddenly on account of mycelial growth in the tracheae. Infection takes place through wounds.

Sporophores were found on the trunk and branches during the rainy season, and are bracket-like, brown to blackish, azonate, annual, usually from 12 to 15 cm. in diameter. The fungus is named *Inonotus schini* n. sp.

DUFRÉNOY (J.). **The occurrence of Cronartium ribicola in Europe.** —*Phytopath.*, xii, 6, pp. 302–304, 1922.

In Europe the accidial stage of *Cronartium ribicola* chiefly occurs on the Weymouth pine (*Pinus strobus*), though *P. lambertiana* and *P. flexilis* may also be infected. The disease has not been observed in southern or central France. The teleuto stage is uncommon, and has never been seen by the author on wild *Ribes*. References are given to the published records of the distribution of this fungus in some other European countries.

MACCALLUM (BELLA D.). **Some wood-staining fungi.**—*Trans. Brit. Mycol. Soc.*, vii, 4, pp. 231–236, 2 pl., 1922.

After a short reference to the literature on wood-staining fungi, the author states that 'blue-rot' has been known for many years in Great Britain, and it has been assumed to be caused by one or more species of *Ceratostomella*, without, so far as she knows, any description of the species concerned. Her present investigation showed that *C. pini* Münch and *C. piceae* Münch occur very commonly in and around Edinburgh, and in all the woods visited between that town and Inverness. In all the cases affecting standing

trees which have come under observation the bark of the tree was riddled with holes made by the pine beetle *Hylesinus piniperda*.

The author gives a detailed account, based on the study of artificial cultures, of the life-history of *C. piceae*. This species occurs as a nearly pure growth on *Picea excelsa*. It is not certain how far it stains the wood. In Scotland spruce timber is quite unstained by it even when perithecia occur thickly all over the surface. It occurs very frequently on badly stained *Pinus sylvestris*, but has never been found unaccompanied by other fungi, with which it is inextricably mingled. Pure cultures on sterilized blocks caused only a very slight discoloration.

Cultures started from ascopores rapidly give rise to conidia of the *Cladosporium* type. Later on a *Graphium* form appears, probably *G. penicillioides* Corda. Perithecia were formed in culture in about two weeks. Attempts to isolate single ascopores failed owing to their slimy covering. Cultures from single *Graphium* conidia only gave conidial forms. Cultures from single *Cladosporium* conidia have, however, given the perithecial stage as well as the *Graphium* form, and though the author does not consider the evidence complete owing to the few successful cases, she thinks that Münch was correct in including a *Graphium* stage in the life-history of *C. piceae*.

WILSON (M.). **The blueing of coniferous timber.**—*Trans. Roy. Scot. Arbor. Soc.*, xxxvi, 1, pp. 82–92, 1922.

This paper is a concise account of the present state of knowledge of the blueing of coniferous timber, which the author states is widely distributed in Great Britain with the result that a considerable quantity of affected timber is being put on the market. Blued wood is graded and priced considerably lower than sound timber, and is frequently rejected for such purposes as pit props, sleepers, shipbuilding, &c. Its value for furniture construction is also usually reduced by 25 to 50 per cent.

The fungi most frequently found in blued wood are mentioned, and details are given of the investigations in other countries as well as in Great Britain regarding their life-history, the conditions favouring their attacks, and their effect on the wood.

It is concluded that blued wood is slightly weaker than healthy timber and should not be used for structural purposes where failure would result in serious consequences.

BONAR (L.). **The life-history of Rosellinia caryae sp. nov. causing a Hickory canker and disease.**—*Phytopath.*, xii, 8, pp. 381–385, 3 figs., 1922.

A disease of hickory (*Carya ovata*) was found in Michigan in the spring of 1921. Affected branches showed dead, sunken areas on otherwise vigorously growing, young shoots. There was a high percentage of canker among the younger growth. The cankers varied in size from mere spots to patches 6 in. by 3 in. in diameter, and nearly always occurred round the leaf scars or on the tips. Examination of the diseased areas on the younger twigs showed abundant fruiting bodies of a fungus in the bark, which broke through the periderm in isolated, small pustules. These proved to

be pycnidial structures, somewhat variable in form, growing immediately beneath the periderm, which ruptures and exposes a black dome. In section a black, differentiated wall over the top only is seen. Subsequently, however, the black wall develops downward all the way round except a narrow portion at the base.

There is no definite ostiole, but the hymenial layer extends over the entire inner surface of the pycnidium. Hyaline spores, broadly fusoid, usually containing oil globules, 5 to 7 by 2·5 to 3 μ are borne in great profusion on Indian club-shaped conidiophores. At maturity the pycnidium ruptures irregularly, the upper carbonaceous part frequently breaking away and leaving a cup-like cavity.

The fungus grew readily from single spore isolations on sterilized green bean pods or green bean agar. Pycnidia formed in artificial culture had a pycnidial wall all the way round, a slight papilla-like growth similar to an ostiole being observed in some cases. Clean hickory twigs inoculated with a pure culture of the fungus became covered with mycelium in which pycnidia formed.

The ascigerous stage of the fungus was developed on naturally infected twigs, sterilized on the outside with corrosive sublimate and kept in sterile tubes for six months. Single ascospore cultures gave rise to the pycnidial stage. The fungus falls into the genus *Rosellinia*, and the species being hitherto undescribed the name of *R. caryae* is given, together with a technical description. The imperfect stage agrees with the characteristics of the genus *Dothichiza* as understood by Diedicke, but, like the other members of this genus, comes very near *Phomopsis*.

SCHMITZ (H.). **Studies in wood decay. III. The toxicity of Western Yellow Pine crude oil to Lenzites saepiaria Fries.**—*Journ. Indus. and Engin. Chem.*, xiv, 7, pp. 617–618, 1922.

Crude western yellow pine oil is a heavy, syrupy liquid, acid in reaction, and with a sharp, pungent odour. In order to test its value as a wood preservative, it was added, in concentrations ranging from 0·5 to 15 per cent., to cultures of *Lenzites saepiaria* grown on sawdust from lowland white fir (*Abies grandis*), Douglas fir (*Pseudotsuga taxifolia*), and sugar maple (*Acer saccharum*). The culture flasks were kept under observation for three weeks and examined at frequent intervals. It was found that the toxic concentration, calculated on the dry weight of the sawdust, was 9 to 10 per cent. in white fir, 10 to 11 per cent. in Douglas fir, and 11 to 12 per cent. in sugar maple. Nine per cent. of the oil was lost by evaporation when the impregnated sawdust was exposed to the air for twenty-four hours.

The ideal way of examining the toxicity of wood preservatives to wood-destroying fungi would be to set up a culture series as described above, and ascertain the extent of the actual decomposition of the wood as indicated by the loss in weight in each flask. There are, however, several drawbacks to such a method, the most serious of which are the lengthy incubation period (at least three months) before reliable results would be obtained, and, with volatile substances (coal-tar creosote, wood tar, &c.), the loss in weight due to evaporation. The latter objection does not apply to non-volatile substances, such as zinc chloride, sodium fluoride, &c., and the method

is now in use in connexion with an investigation of the effects of soil alkali on the rate of decay of wood.

A further experiment on the toxicity of yellow pine oil was carried out on a medium of hard potato agar, to which the oil was added in concentrations varying from 0·05 to 1·4 per cent. The plates were then inoculated from plate cultures of *L. saepiaria* and incubated for four weeks at 24° C. The toxic concentration was found to be between 0·5 and 0·6 per cent. It is apparent from these results that the toxic properties of western yellow pine oil are very limited.

MATSUMOTO (T.). **Some experiments with Azuki-Bean mosaic.**—*Phytopath.*, xii, 6, pp. 295–297, 2 figs., 1922.

In July 1921 a considerable amount of mosaic disease was found among Azuki beans (*Phaseolus radiatus* var. *aurea*) at the Morioka College of Agriculture and Dendrology, Japan. The anatomical characters of the light and dark green areas in the mottled leaves are illustrated and briefly described. They are similar to those of mosaic cucumber leaves as described by Doolittle. It was shown by tests that the accumulation of starch, and probably also of sugar, was greater in the dark than in the light areas. Some varieties were found to escape the disease, but it was not determined whether they were entirely immune.

The disease is a typical mosaic, resembling that of the soy-bean.

VAN POETEREN (N.). **Verslag over de Werkzaamheden van den Plantenziektenkundigen Dienst in de Jaren 1920 en 1921** [Report of the work of the Phytopathological Service during the years 1920 and 1921.]—*Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen*, 27, 90 pp., 2 pl., 1922.

In this publication is presented a general survey of the incidence and severity of plant diseases in Holland during the years 1920 and 1921. With the reorganization of the Dutch Phytopathological Service in 1919 provision has been made for closer contact with the actual cultivators throughout the country, and a more complete report of the situation as regards plant diseases in Holland is now possible than was formerly the case. The staff consists of a director, four pathologists, an ornithologist, two agricultural and horticultural consultants, and twenty-four technical officers and inspectors stationed in different parts of the country, besides administrative and laboratory assistants. The Institute for Phytopathology at Wageningen is concentrating on the study of certain diseases of major importance, the causes of which are insufficiently known, while the Phytopathological Service, distinct from, but working in close contact with the Institute, handles all other phytopathological matters, including the administration of the various legislative measures dealing with plant diseases and pests. Research work is not undertaken by the Service unless other duties permit; experimental work, especially in the causation and treatment of disease, is, however, carried on.

The present report contains a mass of information, and it is impossible to give more than a brief mention of certain points of special interest.

CEREALS. The scab and foot rot caused by *Gibberella saubinetii* was common on oats. It is noted that, though the *Fusarium* stage of this fungus was found attacking wheat, barley, rye, clover, &c., perithecia were only observed on oats in Holland previous to 1920, when they were found on wheat. Seed disinfection with 1 per cent. uspulun or 0·5 per cent. corrosive sublimate is recommended for this disease. The perithecia of *Pleospora trichostoma* were found on the glumes of germinated grain of barley, the seedlings from which were affected by stripe disease (*Helminthosporium gramineum*) and even on those from which the seedlings, though weakly, were not marked by definite stripes. It was further found that perithecia could be induced to form on glumes of unthreshed barley when incubated for three days in a warm, moist atmosphere, and this suggests a method of determining whether a sample of grain is infected by the disease.

POTATOES were extensively attacked with streak ('stippelstreepziekte') in the northern part of the country in 1921. Rotting of the tops of the shoots before they were up was caused by *Rhizoctonia solani*. Tuber disinfection with corrosive sublimate against the latter disease has now become a practice in some places.

BEET. Severe damage was caused by *Peronospora schachtii* in 1920 and by *Rhizoctonia violacea* in 1921.

FLAX. In 1921 the crops in various parts of Zuid-Beveland were so severely diseased that they had to be ploughed up. The damage was apparently caused by an unusually virulent strain of *Botrytis cinerea*, which attacked the stalks and even the underground parts, and was perhaps favoured by the drought.

FRUIT. In 1921 *Fusarium gemmiperda* was found associated with a disease which destroyed many pear buds, but whether the disease was due to this fungus or to some physiological cause was not determined. A purple-coloured decay of the interior of cooking pears was associated with a fungus which formed pycnidia somewhat resembling *Fusicoccum* in pure culture. The fungus is believed to be a new genus. Other rotting pears were found to bear pycnidia of a *Phomopsis* (probably *Ph. ambigua*). *Roesleria hypogaea* was found on pear roots (which were extensively rotted by it) in 1921. This is the first Dutch record of damage caused by this fungus. Raspberries were attacked by *Coniothyrium fuckelii* and a red *Fusarium*; good results were got by spraying with Bordeaux mixture and lime-sulphur. A bacterial disease of cherries, which appeared to correspond to that described in Flugblatt 39 (1910) of the Biologische Anstalt at Dahlem, was observed in 1920. Red currants were attacked by *Collybia velutipes*, a fungus that may grow for years within the tissues of the branches before fructifying on the surface. A species of *Coniothyrium* is thought to cause the so-called 'marginal blight' of German sour red currants, previously reported. A disease of gooseberries, resulting in the discoloration and death of the twigs, was observed in 1920; a species of *Phytophthora* was isolated from the diseased wood and successful inoculations were obtained. Experiments in the control of American gooseberry mildew [*Sphaerotheca mors-uvae*] gave excellent results with alkaline Burgundy mixture (1·5 kg. copper sulphate and 1·5 kg. soda ['sodex'] to 100 litres of water). It

should be applied before the first appearance of the mildew. Good results were also obtained with 3 per cent. carbolineum solution, but the growth of the plants was arrested for a time.

Amongst the numerous records of diseases in garden vegetables and ornamental plants may be mentioned a minor disease of bean pods caused by *Isariopsis griseola*; an attack of *Phoma oleracea* on Brussels sprouts, the fungus being disseminated with the seed; a 'spot' disease of cabbage, very prevalent in 1921 and believed to be caused by a bacterium; the spinach disease described by Schoevers in 1918 [*Meded. Landbouwhoogeschool, Wageningen*, xv, p. 75] in which the same so-called 'X organisms' were again found and thought by Stahel to have an interest in connexion with the *Euphorbia* latex flagellates; an attack of a *Urocystis*, apparently *U. colchici*, on the bulbs of *Bulbocodium vernum*, of *Pythium de Baryanum* on *Pelargonium* cuttings, *Entyloma* (?) *calendulae* on Dahlia leaves, and *Diplodia lycopersici* on *Capsicum annuum*.

A section of the report is devoted to the effects of the drought of 1921. The dry, hot, summer was favourable to the development of potato leaf roll and *Rhizoctonia solani* but unfavourable to the wart disease parasite, *Synchytrium endobioticum*. Tests of a number of fungicides, chiefly proprietary preparations, are reported. A few of the more interesting diseases are illustrated.

MIÈGE (E.). **Observations sur quelques maladies des plantes cultivées au Maroc en 1921.**—[Notes on some diseases of cultivated plants in Morocco in 1921.]—*Bull. Soc. Path. Vég. de France*, ix, 2, pp. 102–108, 1922.

Notes are given on the principal diseases of crops observed by the author in Morocco in 1921. Mildew (*Erysiphe graminis*) and the various cereal rusts were severe. No resistance to rust was noticed in *Triticum durum*, *T. turgidum*, or *T. monococcum*. *Septoria graminearum* injured some varieties of wheat and oats, and *Fusarium hordearum* Duc. was found on barley. The same common cereal smuts as previously recorded [see this *Review* 1, p. 34], were again present.

Potato blight (*Phytophthora infestans*) caused a good deal of damage. It appeared first in April on the crop sown in January and in early December on that sown in October. *Alternaria solani* frequently accompanied the *Phytophthora*. *Fusarium solani* and *Verticillium albo-atrum* did little damage. Mosaic and leaf roll were also observed, as well as another disease, believed to be new, which is more fully described elsewhere [see below p. 86]. Tomatoes were attacked by a *Fusarium* which caused a collar rot, and by a *Macrosporium*. Leaf roll was also seen on this crop.

Other parasitic fungi observed on cultivated plants included *Cyclogonium oleaginum* on olives, *Septoria apii* on celery, *Uromyces fabae* on beans (occasionally causing much damage), *Plasmopara viticola* and *Oidium* [*Uncinula necator*] on vines (vine mildew severe in certain districts in spite of repeated treatments, and increasing with the extension of European vine-growing; *Oidium* common in coastal regions), *Melampsora lini* on flax (slight), *Cercospora beticola* and *Uromyces betae* wherever beet was grown, *Cercospora violae* on violet, and *Peronospora trifoliorum* on clover.

SMITH (E. F.). **Appositional growth in crown-gall tumors and in cancers.**—Reprinted from *Journ. of Cancer Research*, vii, 1, 49 pp., 4 figs., 28 pl., 1922.

The author has found in various crown gall tumours produced by *Bacterium tumefaciens* in tobacco, *Chrysanthemum frutescens*, and other plants, that normal tissue cells around the tumour become converted by division into tumour cells. The phenomenon is figured in one of his earlier papers but not mentioned in the text. It is stated to be distinct from the ordinary irritational hyperplasia which also occurs in the vicinity of many crown galls, in that whereas the cells in the latter case have a normal arrangement, normal staining properties, and normal functions, those here described are smaller, more or less disoriented, and stain and behave like tumour cells.

The particular cases described and very fully illustrated by photomicrographs in the present paper are the result of fifteen single, shallow, needle-prick inoculations in the cortex of the stem of two young, growing tobacco plants, the galls being removed for examination after three weeks. In all cases there is the plainest evidence of growth of the tumour 'by apposition', that is by the conversion of adjacent normal cortex cells into tumour cells, of which a hundred or more may arise from the division of a single cortex cell. Beyond the tissue in process of active conversion is an area in which the cortex cells are enlarging (often to twice their normal diameter) and have large nuclei.

The bearing of these observations on the controversy regarding the growth of animal cancer tumours by apposition is very fully discussed, the author ranging himself on the side of those who believe that such growth takes place. In crown gall he is inclined to think that growth by apposition is the common form of growth and that, at least very often, the apparent invasion of surrounding tissues by the tumour cells and the formation of the 'tumour strands' previously described by him, is the result of appositional growth in one direction only, a narrow strand of normal tissue becoming converted by the division of its cells into an extension of the tumour. Possibly all the tumour strands originate in this way.

The first stage in the conversion of a normal cortex cell into tumour cells is the enlargement of the former; then it divides (apparently always by mitosis) very rapidly, and one can see 4, 8, or 16 smaller cells enclosed by the stretched and thickened wall of the original cortex cell. Division goes on until a mass of small tumour cells, with no intercellular spaces, is formed. Later on these cells may enlarge so as to equal or even exceed in size those from which they originated. The stimulus causing these changes may be a chemico-physical one derived from the bacteria and acting at a distance from them, or it may be due to a direct transfer of the bacteria from cell to cell through the pits in the cell walls. The author believes that the appositional hyperplasia is due to the latter cause, whereas the hypertrophy prior to division may be due to the former.

In nearly all the tumours examined in this series, the vascular cylinder had been split open by the appositional growth of the tumour along the medullary rays, and the pith was in process of

invasion. In certain cases downward extension (in the direction of the axis of the stem) occurred in a narrow strand along the medullary ray, thus originating a longitudinal tumour strand. In the outer pith, in some cases, various scattered, small tumours were found which were not connected in any evident way, such as by the presence of tumour strands, with the main tumour. The author supposes that these secondary tumours originated by the liberation of mobile bacteria from tumour cells, crushed during the splitting of the vascular cylinder, into the intercellular spaces or fissures in the neighbourhood, along which they passed to reach torn pith cells further in, converting the latter into new centres of tumour formation. The author distinguishes these cases from the formation of secondary tumours by metastasis, i.e. by the tumour strands previously described, under the term 'pseudometastases'.

TROST (J. F.). **Relation of the character of the endosperm to the susceptibility of dent Corn to root rotting.**—*U.S. Dept. of Agric. Bull.*, 1062, 7 pp., 2 pl., 1922.

In the course of investigations in Indiana on the various rots of maize, the ears were classified on the basis of the endosperm with a view to determining the possibility of the recognition and elimination of infected ears. Six degrees of starchiness were recognized and designated as types A to F. Most of the ears studied were included in the range of types C, D, and E, in which one half, one quarter, or less of the endosperm was starchy. There was a tendency to greater starchiness in the larger, late-maturing strains grown in the south of the State than in the northern varieties.

Experiments with a number of varieties showed that the starchy ears, especially types C and D, were in every case characterized by a higher percentage of infection from *Fusarium* spp., *Diplodia zeae*, or *Penicillium* spp. than the horny ears (types E and F). The average degree of infection in the starchy group was 50·9 per cent. and in the horny group 33·5 per cent.

It was apparent from an experiment with nine separate strains of the Reid Yellow Dent variety that the variations in the character of the endosperm in different ears may be as great within a strain as among distinct varieties.

In starchy ears a number of factors contribute to the increase of infection. Starchiness is indicative of immature ears, and in the late-ripening varieties the less advanced ears are exposed to attack while maturing under weather conditions more favourable to infection by the root-rotting organisms. The high moisture content of immature ears is also more suitable for the development of external fungi. An unbalanced food supply or a root-rotted condition of the parent stalk also leads to the ears being starchy, and the latter is perhaps the most important factor contributing to infection.

Further experiments showed that, in almost every case, the horny ears produced a higher initial stand in the field, and were healthier and more vigorous than those with starchy grains, and this superiority was maintained throughout the growing season. The yield from the horny grains was also superior to that from starchy ears, the average decrease in yield incurred through the use of starchy seed-ears being estimated at 4·2 per cent.

The data from the experiments are believed to furnish direct evidence of the correlation of resistance to root rots, in dent varieties of maize, with a horny endosperm, and of susceptibility with a starchy endosperm.

ARMSTRONG (S. F.). **The Mendelian inheritance of susceptibility and resistance to yellow rust (Puccinia glumarum Erikss. et Henn.) in Wheat.**—*Journ. Agric. Science*, xii, 1, pp. 57–96, 1922.

During 1917–20 a series of experiments on the susceptibility and resistance to rust of different varieties of wheat was carried out at Cambridge. Biffen's investigations (*Journ. Agric. Sci.*, i, p. 1; ii, p. 109; and iv, p. 421) showed that resistance to yellow rust was inherited as a simple Mendelian recessive character, but owing to the high rate of mortality among his F_3 plants the validity of his conclusions was to some extent impaired. The present researches were intended to clear up the uncertain points.

The varieties chosen for crossing in the main experiment were Wilhelmina and American Club, which differ in several important respects—colour of chaff, length of straw, &c.—as well as in their degree of resistance to yellow rust, American Club being normally immune while Wilhelmina is moderately susceptible. The F_1 plants (1917) derived from this cross were moderately attacked by rust. With regard to the F_2 generation (1918), of 829 plants in the autumn-sown portion, 202 remained rust-free throughout the season, while the remaining 627 proved more or less susceptible. These results closely approximate to the 3 : 1 Mendelian ratio. In the spring-sown portion the proportion of immune individuals was less than one quarter of the total number, but, on the other hand, the number of plants bearing only traces of rust was much higher than in the autumn-sown crop. The F_3 plants (1919) were, almost without exception, more severely attacked than their parents in the previous year. The year 1919 was particularly favourable to the spread of rust, which during the cool and moist weather of July attained the dimensions of an epidemic. It was incidentally observed in the course of that summer that the more susceptible varieties are liable to an earlier successful attack than the more resistant kinds, and also that, at any rate, on susceptible varieties, yellow rust can make rapid progress in the tissues of the host during the hottest weather likely to be experienced in England. The general results obtained from the F_3 cultures may be briefly summarized as follows. Up to 10th July the cultures were sharply divided into three groups. (1) Every plant attacked. (2) No trace of attack. (3) Extent of attack very variable. The homozygous susceptible cultures (1) were all characterized by comparatively early infection, rapid spread of the disease, and exceptional severity of attack. The homozygous 'immune' cultures (2) were characterized by remarkable resistance to attack under most adverse conditions and by the extreme lateness and mild nature of the infection when it did occur. The cultures in which segregation was occurring (3) occupied an intermediate position as regards the period of infection and rust spread, though finally a proportion of the plants was as severely rusted as the homozygous susceptible cultures, while

660 out of 3,045 plants had only a slight attack or none. There is sufficient evidence to show that under very adverse conditions genetically immune plants may be subject to a mild attack. It therefore appears safe to conclude that in the segregating cultures one quarter of the plants were genetically immune, and that these cultures were the product of F_2 heterozygotes for rust resistance. The results of the F_4 cultures (1920) bore out the conclusions drawn from the previous work, the cultures from obviously segregating F_3 plants [group (3)] showing definitely that pure resistant, pure susceptible, and impure susceptible types were present in the F_3 cultures, while the groups (1) and (2) above gave respectively badly rusted and quite or almost quite rust-free plants.

The final conclusion is reached that susceptibility and immunity behave as unit-characters, and depend primarily on definite characters which are inherited according to the simple Mendelian law. This inherited predisposition or resistance to attack is liable to modification by external environmental factors, such as abnormal climatic conditions and the application of certain fertilizers. The greater severity of the attack in 1919 was undoubtedly due in part to the character of the season. But experiments showed that a heavy application of nitrate of soda increased the number of infected plants and the degree of the infection even in the 'immune' lines. Wide spacing also acts in the same direction. In these cases, however, the success of the parasite was of a very limited nature, and did not justify the conclusion that resistance could be destroyed or seriously broken down by the action of such conditions.

The author believes that a re-combination of other inherited characters in a line homozygous for resistance to rust may modify the degree of this resistance. Some of these other characters may obviously modify the metabolism of the plant, and in different combinations it would appear that they may increase or reduce susceptibility or stabilize the inherited resistance. Cases are detailed where factors of this sort appear to have come into play, and are regarded as affording definite promise of the feasibility of breeding stable, highly immune strains.

In an attempt to estimate the reduction in yield due to yellow rust the conclusion is reached that a moderately susceptible variety may give a yield at least 25 per cent. below that obtainable from almost precisely the same form when rendered immune.

ZIMMERMANN (H.). **Typhulapilzbefall der Wintergerste 1921.** [The attack of the *Typhula* fungus on Winter Barley in 1921.] —*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, ii, 6, pp. 41–42, 1922.

In Brandenburg, Mecklenburg-Schwerin, and Mecklenburg-Strelitz the winter barley was found in the early spring of 1921 bearing large numbers of sclerotia of *Typhula graminis*. The leaf sheaths and decaying leaf tissues of the young plants were particularly liable to infection. The plants turned yellow and withered. Eelworms were sometimes also present in the affected plants. Top-dressings with nitrate of soda and sulphate of ammonia, together with thorough hoeing and harrowing, greatly improved the condition of the crop.

STEVENS (F. L.). **The Helminthosporium foot-rot of Wheat, with observations on the morphology of Helminthosporium and on the occurrence of saltation in the genus.**—*Illinois Dept. Registr. and Educ., Div. of Nat. Hist. Survey, Bull.* xiv, Art v, pp. 76–185, 23 figs., 25 diagrams, 34 pl., 1922.

In all cases of the Illinois foot-rot of wheat, which has become known as the 'so-called take-all' disease, examined by the author, the rotten basal portion of the shoot was found largely occupied by a hyaline, septate, vacuolar mycelium of irregular thickness, which grew luxuriantly within the wheat tissue though sparsely on its surface. The mycelium belongs to a species of *Helminthosporium* which is for the present termed *Helminthosporium* No. 1. No other organism has been found constantly associated with the disease.

The cultural characters of this fungus were studied in great detail under various environmental conditions and on numerous media, the best of which were found to be autoclaved cereal shoots (especially maize) and corn-meal agar. A marked effect on growth characters was produced by slight differences in the formulae used or by variations in the temperature at which the medium was prepared. The morphological characters of the fungus were also greatly influenced by environment. The humidity of the medium and of the atmosphere exerted an important influence on the production of conidia and their length, on the amount of aerial mycelium, and on sclerotium formation, the last-named being favoured by relative dryness. This is important in view of the fact that sclerotium formation has been suggested as a character for the separation of certain species. The number and average length of the conidia were much reduced by comparatively dry conditions, while their relative variability was considerably increased. Free conidium formation was only obtained at relative humidities above 90 per cent., and was therefore rare on diseased plants in the field. Gradual drying out may increase the number of conidia per conidiophore from the usual 1 to 3 up to as many as 13. Excessive humidity promoted a profuse development of aerial mycelium. The optimum temperature for the development of the fungus was about 25° C. Diurnal zonation was marked in many cultures, but was much influenced by temperature (being absent at 10° C.), nature of the medium, &c. The presence of carbohydrates in the medium induced a dark coloration of the colonies owing to profuse sporulation, while striking modifications were observed in the conidial length, septation, and shape, as a result of variations in the nutritive or osmotic conditions. Comparisons of colony characters on artificial media should therefore be made only under standard conditions and on substrata as nearly as possible identical in composition. A method for securing this is appended to the *Bulletin*.

The mycelium in wheat tissue was often much thicker than that grown in agar, and occasionally branched in a close, fan-like fashion on the surface. Some races produced mycelial clumps in culture, due to a distortion and crowded growth of the aerial mycelial tips. Anastomoses were frequent. The old aerial mycelium dissolved, probably by auto-digestion. The conidiophores are single, erect, and

darker than the mycelium, and the conidia are borne terminally, growth being renewed from below each of the successively produced conidia, which usually fall and leave lateral scars. The length from base to first scar was 78 to 88 μ.

The colour of the conidia ranges from pale straw to light brown, sometimes with a faint bluish-green tinge. An extremely short, black stipe (2 by 4 μ) remains attached to the basal end after falling. They germinate readily, usually from the basal ends, the endospore and septa being apparently consumed during germination. The exact duration of viability is not known, but the conidia germinated normally on wheat straw that had remained air-dry for fourteen months. The conidia are thickest at a point between the base and the middle. They are described at considerable length, the concepts 'coefficient of longitudinal eccentricity' and 'coefficient of cylindricity' being introduced for purposes of greater accuracy. Conidial length, breadth, and septation are studied biometrically and compared with the corresponding characters of *H. ravenelii*. The average dimensions and septation observed by the author in the case of *Helminthosporium* No. 1 on wheat were as follows: length, 76·8 μ: breadth, 20·4 μ: septa, 7·9.

Inoculation experiments were carried out on maize, wheat, oats, barley, and rye, sixteen other species and strains of *Helminthosporium* being used for comparison with *H.* No. 1. The results of these preliminary tests indicate a wide difference in the susceptibility of cereals to rot by the various forms of *Helminthosporium*, oats being the least liable to infection, and maize and wheat the most. *H.* No. 1 completely rotted a wheat shoot 11 mm. long in five days, maize was rotted less rapidly, and oats, barley, and rye still less; while *H. ravenelii* produced no decay on any cereal. Several other strains showed high rotting power on wheat shoots, especially *H. teres* and *H. sativum* both isolated from barley, and *H.* No. 9 isolated from wheat. *H. interseminatum* from the Centraal Bureau voor Schimmelcultures also caused a rot of wheat. Numerous inoculations of seedlings in Petri dishes, in 'rag doll' germinators, and in soil all gave positive results with *H.* No. 1, the cells of leaf-sheath, stem, and root being rapidly invaded.

Appressoria are formed by the germ-tube prior to penetration, and the cell wall of the epidermis is pierced by a fine infection hypha from the appressorium, a callus-like swelling being formed on the inside of the cell wall. The mycelium grows rapidly within the host cells, often forming a dense mass resembling a pseudo-parenchyma. Other hosts susceptible to the rot caused by *H.* No. 1, besides those mentioned above, were sorghum, Sudan grass, and millet (*Setaria italica*).

Saltation, a term used by the author because of the existing differences in the definition and usage of the term mutation, is much in evidence in certain races of *Helminthosporium*, and is exhibited by the appearance of a sector differing from the rest of the colony in various characters; rate of growth, degree of conidial production, length, breadth, septation, and shape of the conidia, density, colour, and zonation of the mycelium, and sclerotium formation. Certain saltants far exceeded the accepted specific limits in divergence from their parent. The correlation of certain characters in saltation

was observed: thus, colonies of slow linear growth were usually high in conidial production and vice versa. In other cases rapid growth or slow conidial production, verging on sterility, was coupled with paleness of colour; and the development of much aerial mycelium was accompanied by low conidial production. In the main the saltants were permanent in character in subculture. Occasional reversions to the originals occurred, but in no case where the true saltant character was established by constancy through several transfers did the whole stock revert. All attempts to secure artificial saltation by various means failed. Single-conidium cultures gave rise to numerous saltations. As compared with bud-variation on potatoes and tobacco, saltation in *Helminthosporium* is of very frequent occurrence. One hundred and twenty-six variant sectors were studied, and this number might easily have been doubled or trebled. Even supposing some of the forms to have been mere modifications, there was a large proportion of permanent saltants. The author believes that several of the strains received from correspondents were saltants from the original form isolated. A general discussion on saltation and mutation in fungi is given, with references to the work of various investigators.

The author places in the general type *H. sativum* the following elementary species: *H.* No. 1, 1 a, 1 b, 1 c, and 1 d (isolations from foot-rot in Illinois); also his numbers 3 to 9, 11 to 19, 22 to 27, 34, 37, 38, 42, and 43. These include forms sent by correspondents as *H. sativum*, *H. teres*, *H. gramineum*, and *H. avenae*. *H.* No. 20 is an instance of saltation sufficiently pronounced to remove the organism entirely from the group under discussion, though it was descended from Bakke's isolations of *H. sativum*. *H. ravenelii* is a distinct type. Other apparently distinct types are briefly described, including one causing a disease of wheat in the Sudan which is allied to a form isolated by the author from *Setaria italica*. In the author's opinion tenable distinctive diagnoses could be drawn up, through the methods of biometry and a study of biological relations and cultural characters, for many races of *Helminthosporium* on the principal cereals, but whether they should be given distinctive specific names is a question of utility.

A bibliography of 129 entries is appended, and the work is illustrated chiefly by photographs and photomicrographs.

PAXTON (G. E.). **Studies on Helminthosporium species found on cultivated Barley in California.** – Abs. in *Phytopath.*, xii, 9, pp. 446-447, 1922.

The perithecial stage of *Helminthosporium gramineum* was found in California on barley straw two years old. Cultures obtained from the ascospores yielded typical *H. gramineum* conidia and inoculations with the same gave typical lesions of this species. A culture bearing conidia was also obtained from herbarium specimens of *H. gramineum* sixteen years old.

Helminthosporium sativum from barley was grown in pure culture and successfully inoculated on *Hordeum murinum* and vice versa. The optimum temperature for this fungus is about 30° C.

FAWCETT (G. L.). **La 'gomosis' de los Naranjos.** ['Gummosis' of Orange trees.]—*Rev. Industr. y Agric. de Tucumán*, xii, 11–12, pp. 149–155, 5 figs., 1922.

This is a semi-popular account of gummosis of citrus trees, as it occurs in the province of Tucuman, in Argentina. The author distinguishes two forms of the disease: one, which affects the stem at soil level and the root system just below the collar, producing the well-known foot-rot, and another, less common, which is confined to the trunk and branches. The first is due to the attack of various fungi, the most common in Tucuman being *Phytophthora terrestria* [*P. parasitica*]. *Diplodia* is also frequently responsible for the disease, while a *Fusarium* (a form of *Nectria hematochroma*) is sometimes found but is less often parasitic. The disease chiefly attacks trees that have not been budded and has destroyed large numbers of these. Several factors which predispose to it are known, the chief being excessive soil moisture, too deep planting, and faulty methods of irrigation. Gumming of bitter orange trees is believed to be unknown, hence the frequency with which they are used as stocks. Where foot-rot has not made excessive progress, exposing the roots around the collar and excising diseased parts is recommended. The author states that the healing of the wounds thus produced is often more satisfactory when they are exposed to the action of air and light without employing disinfectants. If the latter are used, he recommends Bordeaux paste. The roots may be left exposed for a week or two.

The second form of gummosis is found sometimes on orange trees. Where these are grafted on bitter oranges the affection extends downwards until it is arrested at the union of the two varieties, and this would seem to indicate that grafting at high levels is of advantage. The cause of this form of the disease may be different from that of foot rot, but it has not been fully studied as yet.

MCLEAN (F. T.) & LEE (H. A.). **Pressures required to cause stomatal infection with the Citrus-canker organism.**—*Philipp. Journ. of Science*, xx, 3, pp. 309–320, 2 figs., 1922.

The authors have shown in previous papers that the resistance to canker (*Pseudomonas citri*) of the mandarin orange is due to some character in the epidermis of that species [see this *Review*, i, p. 12], and that the stomata of the resistant mandarin orange differ considerably in structure from those of such a very susceptible species as the grapefruit. These and other investigations suggested that resistance is largely determined by differences in the structure of the stomata and in the degree of their permeability to water. It was decided to test this theory by introducing the canker bacteria into the leaf tissue of the resistant mandarin orange without mechanical injury, and a method was devised of drawing water, containing a suspension of the bacteria, into intact leaves on the tree in the orchard by known and easily measurable pressure. The contrivance employed was an adaptation of the porometer, the construction and mechanism of which are described.

During the dry season (April and May) of 1921, tests were made of the pressure required to inject water alone into citrus leaves by means of the above apparatus. It was ascertained that the degree

of permeability, as judged by visible injection resulting in the appearance of translucent spots, varied greatly in leaves of the same age and on the same tree. Of the citrus varieties tested, the Szinkom mandarin orange, believed to be a native of China, is one of the most canker-resistant horticultural varieties of any species. The grapefruit trees on which the tests were carried out belonged both to the Pernambuco and seedling varieties, and were supplemented by a susceptible type of East Indian pomelo. The susceptible Pernambuco grapefruit and the pomelo were the easiest to inject (average pressures required 19·5 cm. and 19·6 cm. respectively), the highly resistant Szinkom mandarin orange the most difficult (average pressure 33·6 cm.), and the moderately resistant Washington navel intermediate (average pressure 20·8 cm.). These comparative figures indicate that visible injection pressure is an approximate index of resistance to citrus canker.

A suspension of *Pseudomonas citri* was then substituted for the water-bath immersion, young, and therefore susceptible, leaves being used. The temperature of the suspension varied between 28° and 31° C. In the Szinkom mandarin orange infection of the leaves did not usually result until the pressure recorded by 10 cm. of mercury was reached during injection and was not general below 19 or 20 cm., whereas in the grapefruit and pomelo it took place either without pressure or at a very low pressure. The water containing canker organisms was drawn into the leaf tissues at lower pressures than those causing visible injection. The pressure causing visible injection thus appears to be roughly proportionate to, but not identical with, that necessary for infection.

It is evident from the results of the experiments that canker will develop in the leaves of the mandarin orange once the bacteria have gained admission to the leaf, even in the absence of injury to the tissues. It has already been shown in the earlier paper, referred to above, that the stomata of the mandarin orange were so constructed as to preclude the ready ingress of water. The experiments described in the present paper indicate that pressure is necessary for the absorption of water by the stomata of the mandarin orange. On the other hand, the stomata of the grapefruit are constructed in such a way that simple immersion in water containing the bacteria is sufficient to cause infection.

LEE (H. A.). **Relation of the age of Citrus tissues to the susceptibility to Citrus canker.**—*Philipp. Journ. of Science*, xx, 3, pp. 331–339, 4 pl., 1922.

In an earlier paper (*Phytopath.*, xi, p. 70, 1921) the author demonstrated the correlation between advancing maturity and an increasing degree of resistance to citrus canker (*Pseudomonas citri*). The present article describes inoculation experiments undertaken in 1918–19 to gauge the amounts of canker occurring at different stages of maturity. Preliminary tests were conducted in the Philippines on fruits of the pineapple orange (*Citrus sinensis*) and the Valencia orange. The fruits were inoculated from the same suspension of cultures of the bacillus, and maintained under identical environmental conditions favourable for canker formation. The resulting data showed very considerable susceptibility for fruits of a small

diameter, while large fruits approaching maturity were but slightly, if at all, affected.

The experiments were continued in the Nagasaki Prefecture, Japan, on fruits of the Washington navel orange. The fruits were inoculated when the petals dropped in late May and early June, and again at different periods as they approached maturity. The tissues became virtually immune as the fruit ripened. Tests were also carried out on several strains of the Unshiu (Satsuma) orange (*Citrus nobilis* var. *unshiu*). It was ascertained that the total period of possible infection for the Unshiu oranges did not exceed 98 days, as compared with 115 to 120 days for the Washington navel. Further data point to a longer period of susceptibility for the fruit tissues of the grapefruit [*Citrus maxima* (*decumana*)] than for either the Washington navel or the Unshiu oranges.

Exact information on the increase in resistance with advancing maturity of the foliage tissues is very difficult to obtain and of less practical importance. The results of experiments conducted on young, intermediate, and fully matured leaves show that the latter are entirely resistant, the amounts of infection decreasing as the final stages of development are reached. In all the experiments inoculations were made both by means of needle punctures and without puncturing (stomatal infections). The fruits were susceptible to the former for a longer period than to the latter.

The results from this work materially affect field practice for the prevention of canker. In western Japan the fruits of the Washington navel orange are virtually immune from stomatal infection after 85 days and wound infection after 110 to 120 days. Preventive methods may therefore be largely confined to the period from June to August. Canker on Unshiu oranges is uncommon in Japan, being almost negligible from the growers' point of view, and the results with this variety are of less practical interest.

SPINOSA (J. P.). **Apuntes sobre el cultivo del Naranjo referidos especialmente al Territorio Nacional de Misiones.** [Notes on the cultivation of Orange trees, with special reference to the National Territory of Misiones.]— *Bol. Minis. Agric. Nacion. (Argentina)*, xxvii, 1, pp. 3–185, 31 illus., 1922.

This article has been written with the object of attracting citrus growers to the province of Misiones, in Argentina, where climatic and other conditions are highly favourable to the development of this industry. A chapter is devoted to pests and diseases, with full descriptions of symptoms and advice as to the most effective remedial measures.

Amongst fungous diseases, sooty mould is commonly found in the wake of scale and similar insects, though the author states that there are cases where its presence is traceable to purely physiological causes. Spraying with Bordeaux mixture, to which 1 per cent. tobacco extract has been added, has given uniformly good results when the trouble has been due to insect attack. When, however, it originates in excess of humidity and lack of aeration and light, cultural measures to remedy these defects will check it.

Gummosis is a very common disease and a formidable problem in many plantations. The worst outbreaks occur in localities where

conditions generally tend to encourage vigorous growth. The province of Corrientes is at present the greatest sufferer, whole regions having been devastated by this terrible scourge, but its occurrence in other provinces in a more or less virulent form has been observed, and it is feared that the present rapid rate of progress of the disease may eventually kill the industry altogether, unless energetic measures for combating it are taken. Unfortunately the cause of the disease has not been traced with absolute certainty so far, some ascribing it to parasitic action and others to purely physiological causes. The characters of the disease are described and methods for its control discussed. These should include planting in high, well-drained, loamy soil, with a deep and permeable subsoil, to permit vigorous root development; choice of stocks such as the bitter or Seville orange [*C. bigaradia*], the rough brown lemon [*C.* sp.], *C. trifoliata*, and *C. myrtifolia*, which are known to be resistant; and good cultivation. The treatment of affected plants by opening up the collar and main roots and cutting away the diseased tissues, followed by antiseptic treatment of the exposed parts, is recommended.

The author states that in northern Argentina shade is required in the citrus plantations, free exposure to the sun favouring the development of gummosis. Cases are quoted of severe attacks of gummosis following the removal of shade in forest clearings in which wild and semi-wild citrus plants had been retained. Under normal forest conditions these trees are not attacked. He considers that the primary cause of gummosis is unbalanced water relations in the plant, though invasion by parasitic organisms may accentuate the effects.

Other diseases appear to be of minor importance.

HORNE (T.). **A Phomopsis in Grape Fruit from the Isle of Pines, W. I., with notes on Diplodia natalensis.**—*Phytopath.*, xii, 9, pp. 414–418, 2 pl., 1 fig., 1922.

In a cargo of grapefruits shipped from the Isle of Pines, W. I., two fruits with a tan-coloured rot were obtained on arrival at San Francisco. From the first *Diplodia natalensis* was isolated, and produced stem-end rot in grapefruits and oranges on inoculation. The other yielded the more delicate, white mycelium of a *Phomopsis*. In the later stages of rotting caused by this fungus the colour was uniformly smoky-brown below the surface, in contrast with the black colour shown by the *Diplodia* at the same level.

The *Phomopsis*, which is considered to be a new species and named *P. caribaea*, gives a white mycelium, sometimes becoming slightly tinted brown, in culture. Dark brown sclerotial bodies, less than 0·5 mm. in diameter, are formed in some media, small, conical pycnidia in others. The lower (newer and moister) pycnidia in the tube cultures mostly bear the scolecospores or B-spores, 20 to 32 by 1 μ, while the upper pycnidia bear chiefly the pycnospores or A-spores, 5·6 to 8 by 2·2 to 3 μ.

Inoculations on grapefruit caused the development of a typical stem-end rot in several cases, though the rot was not fully developed until after about three months. On oranges the parasitism of the fungus was doubtful.

FACWETT (H. S.). **A new Phomopsis of Citrus in California.**—*Phytopath.*, xii, 9, pp. 419–424, 2 figs., 1922.

From citrus fruits affected with stem-end rot in packing houses in Santa Barbara County a *Phomopsis* was isolated. The trouble appeared to be of minor importance, only fruits picked when quite mature or stored for a long time being very occasionally attacked. No fruit with stem-end rot was found in the orchards, but *Phomopsis* pycnidia were discovered on a few dead twigs, and some leaves gave indication of melanose, a condition which, in Florida, is characteristic of attack by *Phomopsis citri*. Some mature fruits picked from branches containing dead twigs, and kept in the laboratory, developed stem-end rot in about five weeks. The fungus was commonly found in the bark of lemon trees affected with 'shell bark', and from inoculation tests it would appear not improbable that it is a factor in the development of the shell bark disease.

Inoculation experiments are described which indicate that the fungus differs from *P. citri*, the species responsible for stem-end rot in Florida. The weaker virulence of the Californian fungus, its lower optimum temperature for growth (20·5° C. as against 24° C.), differences in mycelial growth (fan-like, irregular, surface growth, turning brown on potato and cornmeal agar), and spore production (B-spores predominating on a variety of culture media), have led the author to form a new species *P. californica*. This cannot be distinguished from *P. citri* by spore measurements alone.

RAST (L. E.). **Control of Cotton wilt by the use of potash fertilizers.**—*Journ. Amer. Soc. Agron.*, xiv, 6, pp. 222–224, 3 figs., 1922.

During the spring of 1920 several five-acre fertilizer experiments were conducted on different cotton plantations on alluvial river land. Different combinations of fertilizers were used at each place, at the rate of 500 lb. per acre. One grower used a mixture containing 10 per cent. phosphoric acid, 3 per cent. nitrogen, and no potash. In his fields the cotton plants on both the fertilized and unfertilized areas died to such an extent that no record was kept of the yield. In the spring of 1921 equal parts of the same fertilizer and of kainit containing 12·5 per cent. potash were mixed and applied to a portion of this area, at the rate of 1,000 lb. per acre, before planting. The plants on the unfertilized area began to die long before reaching maturity, and by harvest time 95 per cent. were dead, evidently as the result of an attack of wilt [*Fusarium vasinfectum*]. There was not a single death on the corresponding area to which the complete fertilizer was applied. The fertilized area produced 1,127 lb. of seed cotton per acre as against 225 lb. on the infected, unfertilized part of the field. Plants on an adjoining area, to which the same combination as in 1920 was applied before planting, but which was given an additional 500 lb. per acre of kainit after the plants were up, were equally resistant and prolific.

The writer believes that this control of cotton wilt was due to the potash in the fertilizer. The identification of the disease was confirmed by Dr. J. A. Elliott, Plant Pathologist at the Arkansas Experiment Station. The experiments will be continued with

various kinds and quantities of potash, both alone and in combination with other plant foods.

JONES (L. R.) & TISDALE (W. B.). **The influence of soil temperature upon the development of Flax wilt.**—*Phytopath.*, xii, 9, pp. 409–413, 1 fig., 1922.

This paper records further studies in continuation of the earlier work of W. H. Tisdale (*Journ. Agric. Res.*, xi, pp. 573–607, 1917), carried out with the improved Wisconsin soil temperature tanks, on the effect of soil temperature on the rate of infection by the flax wilt organism, *Fusarium lini*. Soil was inoculated with a pure culture of this organism, and placed in tanks held at temperatures of 12°, 14°, 16°, 20°, 24°, 28°, 31°, 34°, and 38° C., one hundred flax seeds being planted in each case. The controls were sterilized. The optimum temperature for infection was 24° C., no infection occurring at 12° or at 38°. The critical temperature—determined by W. H. Tisdale as 14° to 16°—was tested in a third series of experiments with soil readings of 14° to 15° and of 16°. In the former tank only one plant showed slight symptoms, whilst in the latter 22 per cent. of the plants were affected. The delicacy of the temperature balance was further shown when the tanks held at 14° to 15° were raised to 16°; within a week 15 per cent. of the plants showed wilt symptoms. The upper temperature limit is almost as strongly defined as the lower, 67 per cent. of the plants wilting at 34° and none at 38° C. The temperature curve for the disease corresponds closely with that for the growth of the parasite.

Comparing the temperature relations of the very similar *Fusarium* diseases of flax, cabbage, and tomato, it is noted that the lower, or critical, temperatures for infection stand in some relation to the optimum temperatures for the hosts, the tomato being a warmer climate plant than cabbage, and still more so than flax, while the critical temperatures for their *Fusarium* wilts are 19°, 16° to 17°, and 14° C. respectively. The geographical distribution of these diseases in the Mississippi valley agrees broadly with these results, tomato wilt being confined to the southern States with its northern range in the latitude of central Illinois, while the maximum virulence of cabbage yellow lies between Ohio to Iowa and Southern Wisconsin, and flax wilt extends to the northern boundary of the United States, and probably into Canada.

HALL (T. R.). **Disease factor in commercial pomology.**—*Better Fruit*, xvii, 2, pp. 5, 6, & 18, 1922.

Instructions are given as to the best methods to employ in the harvesting, storage, and transportation of fruits. It is estimated that careless handling in picking, grading, &c., may reduce the market value of fruit by 50 to 75 per cent. In the case of the more perishable fruits (apple, pear, quince, cherry, lemon, citron, lime, plum, persimmon, grape, strawberry, and fig) the stem should not be pulled out, as the skins are apt to break and admit fungi and bacteria. The stems may safely be removed from the orange, pomelo, peach, apricot, prune, olive, raspberry, dewberry, almond, and walnut. It is extremely important to ascertain the exact stage of maturity for successful picking, and brief directions are given by

which the state of the different fruits may be tested. The construction of packing-cases and the wrapping of the fruits are also described. Oiled apple wraps have been found to retard the life processes considerably, thereby increasing the length of time during which the fruit may safely be kept, besides preventing the dissemination of spores. Low and even temperatures (31° to 32° F.) are also essential during storage and transit. Such blemishes as scald, soft scald, and Jonathan spot may be prevented by these means. Ice scald appears to be due to insufficient oxygen and an accumulation of carbon dioxide within the paper wrappers of peaches, and may be prevented by good ventilation with refrigeration. The water content of most fruits ranges from 80 to 84 per cent., and the atmospheric humidity should not exceed this figure, otherwise moisture will collect on the surface of the fruit and facilitate the action of decay organisms.

Unsuitable conditions of transit frequently impair the resistance of the fruit considerably. The car should be loaded to secure the maximum ventilation, refrigeration, and stability. The packages should be spaced widely enough apart to allow a free circulation of air, but not to permit shifting. False flooring should be installed to promote the maximum circulation around and through the load. The top tier of packages should be below the line of safe refrigeration and well within the cooler portion of the car.

CUNNINGHAM (G. H.). **Silver-blight, Stereum purpureum Pers., its appearance, cause, and preventive treatment.**—*New Zealand Journ. of Agric.*, xxiv, 5, pp. 276–283, 8 figs., 1922.

The symptoms of silver leaf, which is common in New Zealand orchards, are described, and also the life-history of the causal organism (*Stereum purpureum*). In apple orchards it is said to cause a loss of about 1 per cent., on pears even less, but on apricots, peaches and plums, the loss may be well over 10 per cent. It is pointed out that fructifications may be produced in New Zealand at any time of the year, but are found especially during wet weather or in damp localities. The life of the fructification, which produces spores at intervals, may last for several seasons. The spores are the sole means of dissemination of the fungus, and they can only enter the tissues of a tree through some kind of wound or bark injury. The disease can therefore be combated by the removal and destruction of all dead stumps bearing *Stereum* fructifications, and by the dressing of wounds with coal-tar. Spraying is quite useless, as the internal mycelium cannot be reached by such means, and the injection into the tree of substances toxic to the fungus has also failed.

MCKAY (M. B.). **Thielavia basicola on watermelon in Oregon.**—Abs. in *Phytopath.*, xii, 9, p. 445, 1922.

During 1916 diseased watermelon plants were received from Oregon which showed the older leaves turning brown and drying up from the centre of the hill outward, the leaves on the young portions of the runners (then about 18 in. long) being apparently unaffected. The outer tissues of the main stalk, from 1 to 4 in. below the ground, were sometimes severely disintegrated, and had

a scurfy appearance. This diseased tissue contained chlamydospores, and on culturing yielded *Thielavia basicola*. Inoculations of watermelon seedlings gave a vigorous rot in two weeks. This disease was reported on watermelons from Utah by O'Gara in 1915.

LAIDLAW (W.) & BRITTLEBANK (C. C.). **Brown rot of stone fruits.**—*Journ. Dept. Agric. Victoria*, xx, 7, pp. 442–443, 1922.

A series of experiments in the control of brown rot (*Sclerotinia cinerea*), a short description of which is given, was carried out at Bairnsdale, Victoria, in 1921. The disease was extremely severe in the season 1920–21, over 75 per cent. of the peaches in the locality mentioned being destroyed. The following sprays were used on July 28, when the trees were dormant: commercial lime-sulphur, 1 in 9; copper-soda [Burgundy mixture] 6 : 9 : 40, Bordeaux mixture, 6 : 9 : 40; neutral copper acetate, 3 lb. to 40 galls.; copper sulphate, 1 in 10. A second spraying was given when the buds were showing pink, the following being used in place of the above in the same order: commercial lime-sulphur, 1 in 20; copper-soda, 3 : 4½ : 40; Bordeaux mixture, 3 : 2 : 40; neutral copper acetate, 3 lb. to 60 galls.; atomic sulphur, 1 in 10 (used in place of copper sulphate). Three or four weeks before the fruit was ready for picking it was sprayed again, lime-sulphur 1 in 30 and 1 in 40 and atomic sulphur 6 lb. to 60 galls. being used. In the case of the copper-soda, Bordeaux, and copper acetate plots, an extra application of self-boiled lime-sulphur 8 : 8 : 50 was given five weeks after the second spray.

The peach varieties treated were Pullar's Cling, Tuscans, and Goodman's Choice. The best results were obtained with commercial lime-sulphur, the trees being free from brown rot, peach aphis, and leaf injury. Bordeaux and copper-soda also gave very satisfactory results. Copper sulphate and copper acetate were the least effective.

GARBOWSKI (L.). **La lutte contre le blanc du groseillier (Sphaerotheca mors-uvae Berk. et Curt.).** [The struggle against Gooseberry mildew (*Sphaerotheca mors-uvae* Berk. & Curt.).]—*Bull. Soc. Mye. de France*, xxxviii, 2, pp. 98–99, 1922.

This is an account of spraying tests carried out at the Experiment Station for Pomology at Sympheropol (Crimea) in 1917 and 1918. The experiments are stated to have demonstrated the superiority of weak solutions of arsenite of soda (0·01 to 0·02 per cent.) over various concentrations of polysulphides (lime-sulphur solutions)—long held to be the best remedy—and over powdered sulphur in the treatment of American gooseberry mildew. In practice powdered sulphur acts exclusively on the foliage, and almost entirely fails to protect the fruit from infection.

The percentage of bushes bearing contaminated fruits was 51 in those sprayed with arsenite of soda, 83 in those receiving lime-sulphur, and 100 in the controls, which were very heavily attacked. The advantages of the first over the second treatment stand out even more clearly when the comparison is applied to the berries picked from the treated plants. Four degrees of infection were recorded: (1) perfectly healthy berries with no trace of mildew; (2) slightly affected, with small spots; (3) more severely attacked;

(4) very severely attacked, more than half the surface being covered with mildew spots. Marking these degrees as 0, 1, 2, and 3, and taking the infection on the controls to be equal to 100, plants treated with lime-sulphur had an infection figure of 65, while those treated with arsenite of soda had only 28. In comparing the weight of the berries, the difference is still further accentuated, the average weight of healthy berries on each bush being 80·4 per cent. of the total weight with arsenite, 36·6 per cent. with lime-sulphur, and only 3·1 per cent. in the controls.

It is unfortunately the case that arsenite of soda (like lime-sulphur), even in very dilute concentrations, causes burning of the foliage, but the amount of this varies in different varieties. Amongst 25 [unnamed] varieties examined, some retained their foliage uninjured, while others suffered severe burns, or even lost a portion of their leaves.

PUTTERILL (V. A.). **Plant diseases in the Western Provinces. IV. Two diseases of the Loquat.**—*Journ. Dept. Agric. S. Africa*, iv, 4, pp. 332-337, 7 figs., 1922.

The loquat (*Eriobotrya japonica*) is very common in gardens round Cape Town, and a leaf scab, due to a species of *Fusicladium*, was first reported on it from Kenilworth, Capetown, in 1920. In the following year affected fruit was examined, and it was found that loquat scab is very similar to those of the apple and pear [*Venturia inaequalis* and *V. pirina*]. The author thinks that the disease cannot have existed in South Africa for more than nine or ten years. It causes dark olive-green, velvety spots on the under side of the leaves, frequently distorting them, and also produces markings on the fruit which are very similar to those found on scabbed apples. It is not known whether the fungus overwinters on old leaves, as is the case with the allied scabs of other pomaceous fruits, but the loquat being an evergreen this means of bridging the seasons appears hardly necessary. In controlling loquat scab on the lines already known to be effective against pear scab in the Western Province, the method of leaf renewal demands a more frequent application of either Bordeaux (4-4-50) or lime-sulphur (1 in 45), than is the case with the pear, where the complete shedding of the foliage in the autumn facilitates treatment. From April onwards the frequency of the sprayings will depend on the intensity of the disease and on weather conditions, but up to maturity both the fruit and foliage should always have a protective coating of fungicide. From November to April, which is the dry season, sprayings can be reduced to once every two months. Clean cultivation is recommended, and badly diseased twigs should be cut out and burned.

A blight of loquats caused by *Entomosporium* sp., which has so far only been reported from one locality in Cape Province, was found associated with scab. It is also known in other parts of the Union outside the Cape Province. The first symptoms are the appearance of small, circular, shiny, black spots, somewhat convex in shape, which appear on the fruit, while small, circular, reddish-brown spots, surrounded by a yellow zone, stud the leaves, being much less noticeable than the scab markings due to *Fusicladium*.

It is only when the spots on the fruits are numerous and aggregated into patches that the two diseases can be confused. A similar, if not the same species of *Entomosporium* (*E. maculatum* with its perfect stage *Fabraea maculata*) causes leaf blight of the quince and pear, considerable damage from it having been recorded in South Africa, particularly in Natal and in the Orange Free State.

The control measures advocated for scab should apply equally well to this blight, owing to the similarity of the two fungi. It is thought that blight will be more readily controlled than scab, judging by the relative prevalence and severity of the two allied pear diseases, under the prevailing climatic conditions of the Province.

DUTTON (W. C.) & JOHNSTON (S.). **Dusting and spraying experiments of 1920 and 1921.**—*Michigan Agric. Exper. Stat. Special Bull.* 115, 54 pp., 23 figs., 1922.

In this bulletin a long series of dusting and spraying experiments carried out in 1920 and 1921 is described. The first experiment arose from the general practice of growers in Michigan of waiting until the blossom buds have separated (pinking or cluster stage) before spraying for apple scab. Observations indicated that scab infection occurred previous to this, and more information was desired as to the value of spraying at the pre-pinking stage (when the buds first show colour, but before they separate). Three plots were selected for experiment; the first was sprayed according to the normal practice, the second was similarly treated, but an extra spray given at the pre-pinking stage, and a third plot was left as control. Lime-sulphur was used (1¼ in 50), and the results gave 46 per cent. scabbed for plot 1, 16 per cent. for plot 2, and 100 per cent. for the control.

The second series of trials was carried out to obtain information as to the comparative value of dusting and spraying in controlling apple scab and codlin moth. The 1920 experiment was made on 100 twelve year old Grimes Golden trees which were divided into four plots, the first being used as a control, the second sprayed with dilute lime-sulphur with lead arsenate, the third with sulphur-arsenate dust (90 per cent. sulphur, 10 per cent. dry lead arsenate), and the fourth with lime-copper-arsenate dust (80 per cent. hydrated lime, 10 per cent. anhydrous copper sulphate, and 10 per cent. lead arsenate). Four sprayings were applied, and the plots gave 89, 20, 22, and 68 per cent. scab and 10·0, 1·9, 0·5 and 5·0 per cent. codling moth respectively. Lime-sulphur-arsenate solution and sulphur-arsenate dust gave therefore much better results than lime-copper-arsenate dust, but the control of scab was not entirely satisfactory in any case. The fruit was tested on a very high standard; many of the apples would not have been classed as scabby commercially.

The 1921 experiment was similar, but the lime-copper-arsenate dust was omitted. The control gave 75 per cent. scab and 34 per cent. codling moth, the sprayed plot [four times with lime-sulphur (1¼–50) with lead arsenate, and once with Bordeaux with lead arsenate] 8 and 5 per cent. respectively, and the dusted plot [six times with sulphur-arsenate dust (90–10)] gave 8 and 12 per cent. The figures showed that dusting and spraying gave equally

satisfactory control of scab, but that the control of codlin moth by dusting was not so good as by spraying. A further dusting test was made in 1921: sulphur-lime-arsenate of lead dust (80–10–10) being used and seven dustings given. The controls gave 24 to 84 per cent. scabby, and 4 to 41 per cent. wormy fruits, while the dusted area gave 4 to 14 per cent. scabby (except on the late blooming variety Delicious which gave 51) and 7 to 14 per cent. wormy.

To sum up the results of the above dusting trials, sulphur dust, used according to the regular summer schedule, has given satisfactory control of apple scab. Lime-copper-arsenate dust, in the proportions used, has not so far proved successful.

Experiments on pear scab [*Venturia pirina*] were undertaken in 1920 to ascertain whether more than three sprayings are necessary to control this disease, and to compare the respective efficiency of lime-sulphur, sulphur dust, and copper sulphate dust (containing 10 per cent. dehydrated copper sulphate), lead arsenate being added to these materials when necessary. Four applications were given—at pre-pinking, pinking, calyx stage (just after the petals had dropped), and about a fortnight later.

In the first experiment, lime-sulphur (1–50) gave 10 per cent. scabbed; sulphur dust (omitting the last dusting) 15 per cent., and (omitting the pre-pinking dusting) 22 per cent.; copper sulphate dust 23 per cent.; and the control 58 per cent.

In the second experiment, lime-sulphur (1–40) gave 16 per cent.; sulphur dust (4 dustings) 10 per cent.; copper sulphate dust 20 per cent.; and the control 60 per cent.

In the third experiment three dustings [sulphur alone; sulphur-lead arsenate-nicotine sulphate; sulphur-lead arsenate (90–10)] gave 1·9 per cent. scabby and 0·5 per cent. wormy, while three sprayings (Bordeaux; lime-sulphur (1–40)–lead arsenate–Black-leaf 40; Bordeaux-lead arsenate) gave 3·1 per cent. scabby and 1·3 per cent. wormy.

Considering the results of the pear scab control as a whole, dusting and spraying were almost equally effective, but further tests are necessary. Foliage sprayed with lime-sulphur was considerably damaged, especially after the 'calyx' application, while that dusted was uninjured. The value of the pre-pinking spraying was definitely proved.

Brown rot [*Sclerotinia cinerea*] has been the cause of excessive loss of peaches and plums in recent years, apparently healthy fruit decaying before shipment or in transit. This has led to fruit being put on the market in an immature state, resulting in reduced sales and injury to commercial interests. Experiments were therefore undertaken in 1920 and 1921 to develop a satisfactory method of improving the keeping qualities of the fruit by control of brown rot.

In the first experiment, the sprayed trees were treated three times with lime-sulphur (1¼–50) combined with lead-arsenate (1¼ lb. in 50 galls.) and once with lime-sulphur alone, while the dusted trees were treated four times with sulphur-arsenate dust (90–10) and twice with sulphur alone. The results both from spraying and dusting up to the time the fruit was picked were very satis-

factory, while a late application of sulphur dust reduced the development of rot after picking.

In the second experiment, sulphur-hydrated lime-arsenate dust (first dusting 75–15–10, second dusting 85–15–0) gave at the time of picking 0·7 per cent. of peach scab and 3 per cent. of brown rot, while the control gave 18 and 13 per cent. respectively.

A series of experiments was carried out on plums and peaches with the single purpose of finding whether sulphur-hydrated lime dust (85–15 or 90–10) would retard the development of brown rot after picking. The dusted trees invariably gave a lower percentage of brown rot (5 to 35) than the controls (30 to 100). The dusting was done three days to one month before the picking, and the results were taken four to twelve days after picking.

The late application of sulphur dust therefore greatly improves the keeping qualities of the fruit, but such treatment should only be considered as supplementary to the regular summer schedule and not as a substitute for it.

Experiments were also carried out in 1920 and 1921 to test the efficiency of lime-sulphur, Bordeaux, sulphur dust, and dehydrated copper sulphate dust in controlling leaf spot of cherry [*Coccomyces hiemalis*] on the varieties English Morello and Montmorency. On the latter the results were inconclusive owing to the slightness of attack. On the former, however, in 1920, Bordeaux mixture (4–6 hydrated lime–50) gave good control, but caused serious injury to the foliage; lime-sulphur (1¼–50) ranked second, and the two dusts, sulphur-arsenate (90–10) and lime-copper-arsenate (75–15–10) a little lower still. In 1921 the control by all materials [lime-sulphur (1½–50), Bordeaux (4–7 hydrated lime-50), sulphur-arsenate-lime dust (80–10–10), and lime-copper-arsenate dust (70–20–10) with 10 per cent. talc] was almost perfect, but Bordeaux resulted in the fruit being undersized, a similar trouble having recently been reported from the North-West.

Comparative tests of dry and liquid lime-sulphur for the control of apple scab showed, as in previous years, that the latter gave the better results.

Following an experiment made in 1919, another trial was made to control peach leaf curl [*Exoascus deformans*] by dry spraying, but satisfactory control was not obtained with soluble sulphur or Bordeaux dusts.

COONS (G. H.). **Copper dust treatment for stinking smut.**—*Quarterly Bull. Michigan Agric. Exper. Stat.*, v, 1, pp. 8–11, 1 fig., 1922.

Stinking smut or bunt of wheat [*Tilletia tritici*] reduces the Michigan crop by at least 5 per cent. annually. In the autumn of 1921 experiments were carried out on very heavily smutted wheat to determine the comparative efficiency of various methods of control. The following results were obtained: 'dry' formaldehyde [see this *Review*, i, p. 436], 3 per cent. of infection; sprinkling with 1 pint commercial solution of formaldehyde in 40 galls. of water, 0 per cent.; immersing in the same solution and skimming off the unbroken bunt balls, 0·5 per cent.; copper carbonate dust, 2 oz. per

bushel, 1·4 per cent.; dehydrated copper sulphate and lime dust, 2 oz. per bushel, 4 per cent.; untreated, 51 per cent.

The formaldehyde treatments gave satisfactory control, but somewhat reduced the stand. The copper carbonate and copper sulphate-lime dusts would probably effect complete control on ordinary grain fit for seed purposes. The copper dusts had no adverse effects on germination, and their use on a large scale (for wheat only) is recommended.

BOUILLARD (R.). **Emploi du lysol contre la carie.** [Use of lysol against bunt.]—*Journ. Agric. Prat.*, lxxxvi, p. 203, 1922.

The writer states that he has obtained excellent control of bunt by the disinfection of seed wheat with 5 per cent. lysol (200 gm. lysol and 4 litres of water per hectolitre of seed). Not a trace of the disease has been observed during the four years over which the tests have extended. Compared with copper sulphate, lysol appears very slightly to retard germination (one to three days), but no difference is noticeable at maturity. The retail price of lysol is slightly higher than that of copper sulphate, but the former is in several respects more convenient. Seed steeped in lysol in the morning can be sown the same evening, and the preparation of the mixture is very simple. Seed which has been thoroughly treated by lysol assumes a light walnut tint. The treatment is applied by sprinkling the grain, which should be well shovelled over during the process.

KLAPHAAK (P. J.) & BARTLETT (H. H.). **A preliminary notice of genetical studies of resistance to mildew in Oenothera.**—*Amer. Journ. of Bot.*, ix, 8, pp. 446–458, 1922.

Oenotheras grown for experimental purposes showed that nothing is more characteristic of the various elementary species and hybrids than the great difference they exhibit in susceptibility to mildew (*Erysiphe polygoni*). Such material therefore offered an excellent opportunity for an investigation of the inheritance of disease resistance, part of the results of which are given in this paper.

General observation indicated that susceptible species when crossed reciprocally with immune ones gave only one immune cross. It was not possible to get immune hybrids by crossing susceptible parents, while in the case of crosses between immune strains, both reciprocals might be immune, or one of them immune and the other susceptible.

In earlier papers the hypothesis of heterogametism has been formulated (Bartlett, *Amer. Nat.*, 50, pp. 513–529, 1916, and Cobb and Bartlett, *Journ. Wash. Acad. Sc.*, 9, pp. 462–483, 1919) according to which each species of *Oenothera* is supposed to produce two types of gametes called α and β gametes. The former are generally the female ones and the latter the male, but in a few exceptions the pistil may transmit the β gametes and the pollen the α, in which case instead of a normal hybrid of $\alpha\,\beta$ combination, usually similar in character to one of its parents, a metaclinic hybrid $\beta\,\alpha$ is produced, which plant resembles the reciprocal cross.

The hypothesis which is suggested to account for immunity is as follows. The immune strains carry a factor **I** for immunity, the

susceptible strains a factor **i** which denotes absence of immunity or presence of a factor for susceptibility. If in an immune strain only one type of gamete bears the **I** factor, and if only $\alpha\beta$ combinations are viable, then such a strain will breed true for immunity but will give a susceptible hybrid, one way or the other, when reciprocally crossed with a susceptible strain. **I** is considered to be the dominant factor and may be an attribute of the α gamete or the β gamete.

On the basis of the above hypothesis the authors have worked out the zygotic composition of the five strains of *Oenothera* selected for the experiments as follows:—

Oenothera pratincola ('Lexington C')	α **i** β **i**, susceptible.
'*Oe. biennis Chicago*'	α **i** β **i**, susceptible.
Oe. mississippiensis	α **i** β **i**, susceptible.
Oe. pratincola hyb. *immunis*	α **i** β **I**, immune.
Oe. cinerescens	α **I** β **i**, immune.

Ersiphe polygoni appeared to show indications of the existence of 'biologic strains', as conidia from the pea did not produce infection on *Oenothera* whilst conidia from *Oenothera* did so. No morphological differences could be correlated with this behaviour.

In planning the experiments the immune strains were freely tested as regards immunity, by growing them among highly susceptible ones. The objection that strains of *E. polygoni* might exist elsewhere which would infect the so-called immune strains of *Oenothera* is hardly revelant, since the authors are concerned not with the production of disease-free plants, but rather with the fact that immunity to certain strains of *E. polygoni* exists, and that such immunity acts as a dominant unit factor in heredity.

Details are given of numerous crosses made with the five strains of *Oenothera* mentioned above, each strain being selfed and also crossed with the four remaining ones. Three examples may be cited as illustrative of the crosses made, the pistillate parent being named first in each case.

(1) *Oe. mississippiensis* (susceptible) × *Oe. cinerescens* (immune) gave all susceptible progeny of the constitution α **i** β **i** with the exception of one metaclinic plant which was immune. In the reciprocal cross, the progeny, α **I** β **i**, were all immune except in the case of one metaclinic plant of the type *Oe. mississippiensis*, which was susceptible.

(2) *Oe. mississippiensis* (susceptible) × *Oe. pratincola* hyb. *immunis* (immune) gave all immune progeny (α **i** β **I**) of the *mississippiensis* type. From the reciprocal cross, all the progeny (α **i** β **i**) except one, a mutation, were matroclinic and resembled *Oe. pratincola* except in susceptibility to mildew.

(3) *Oe. cinerescens* (immune) × *Oe. pratincola* hyb. *immunis* (immune) gave all immune progeny (α **I** β **I**), and the reciprocal cross gave all susceptible plants (α **i** β **i**).

In every one of the cases analyzed in this way the reaction of the hybrid to mildew conformed exactly to expectations, according to the formulation above.

On account of the peculiar type of heterogametism in *Oenothera*, immunity due to a single factor must breed as true as that due to a factor pair.

The F_2 generation obtained by self pollination of the hybrids

showed the same characteristics as regards susceptibility or immunity as the F_1 generation, a result which should have been expected on the basis of the authors' hypotheses of heterogametism and immunity.

In the case of metaclinic hybrids from immune and susceptible parents, the immunity factor combination which would insure susceptibility or immunity in one particular type seems not to insure the same effect in another type. Further investigations have been started on this matter, but so far as the normal hybrids are concerned the results are all consistent.

BONAR (L.). **An albino mutation of the Dematiaceous fungus Brachysporium trifolii.**—*Science*, N.S. lvi, pp. 226-227, 1922.

Cultures of *B. trifolii* were started from a single spore in October 1919, and have been continued as a pure strain ever since. The fungus is normally of the *Dematiaceous* type, with dark brown hyphae forming a dense, black mat in and on the culture medium. In one of a series of cultures made in November 1921, a sector of growth appeared which completely lacked the usual dark brown colour, although the mycelium and conidia were identical in all other respects with the normal growth.

Pure cultures of the albino material were carried on through sixteen consecutive non-sexual generations without any variation in the appearance or nature of the strain. The mycelium in mass is a true albino or may at times assume a pale flesh colour. Every modification in conditions thought of was used in these cultures for the two and a half years they have been maintained, and there has been an entire absence of any sexual process either in the normal or albino strains. The phenomenon of albino mutation must therefore be referred to some sudden change, hitherto inexplicable, in the mycelium or conidia of the normal strain.

LAGERBERG (T.). **Cordiceps militaris (L.) Link i Sverige.** [*Cordiceps militaris* (L.) Link in Sweden.]—*Svensk Botan. Tidskr.*, xvi, 2, pp. 285-290, 2 figs., 1922.

The author found *Cordiceps militaris* in 1920 and 1921 on larvae of *Smerinthus populi*, *Cymatophora flavicornis*, and *C. duplaris*. The locality was a ravine in South Dalarne, the trees in which were mainly *Populus tremula* and *Salix*. The soil humus was markedly alkaline and the ground was covered with a layer of damp, rotting foliage. Further ecological particulars of the locality are given, together with a list of the mosses, ferns, grasses, &c., represented there.

According to Bülow (*Svampar*, 3rd Ed., p. 253, 1919), *C. militaris* is extremely rare in Sweden, but may be found year after year in the same place. The fungus is represented by only a very few specimens in Swedish collections. A brief description of its macroscopic characters and life-history is given.

JOHNSON (J.). **The relation of air temperature to the mosaic disease of Potatoes and other plants.**—*Phytopath.*, xii, 9, pp. 438-440, 1 fig., 1922.

Following his previous work on the temperature relations of the

mosaic disease of tobacco [see this *Review*, i, p. 243], the author gives the results of similar experiments which he has conducted with mosaic diseases of potatoes, tomatoes, soy-beans, pea-beans, and clover.

Young potato plants showing symptoms of mosaic were placed in air-control chambers held at temperatures ranging between 6° and 36° C. for one to three weeks, parts of the individual tubers in each series being represented in each chamber. The effect of temperature was gauged by the intensity of the symptoms of the mosaic or the rate of 'recovery' from the disease.

The results have shown that temperatures as low as 6° C. seemingly do not inhibit the disease, which persists at temperatures where the potato makes little or no growth. Taking the growth of the host into consideration, the optimum temperature for the disease lies between 14° and 18° C. Above 20° C. symptoms disappear, but a temperature of 24° to 25° C. is necessary to cause them to disappear in one to two weeks (old leaves taking longer to 'recover' than young ones), so that this temperature may be regarded as the maximum temperature for mosaic manifestation in the potato.

The expectation that exposure to high temperatures would destroy the mosaic virus has not been realized so far, although the effect of exposure for 10 days at 36° C., while not entirely destroying the virus, indicated that longer treatment may be effective without destroying the germination of the tuber.

Certain other mosaic diseases, worked with in less detail, have responded to temperature, some, like tomato mosaic (inoculated with tobacco virus), falling in the high temperature class with tobacco, others, like clover mosaic, in the low temperature class, and others being intermediate. Soy-bean mosaic is inhibited at temperatures of from 26° to 28° C., but the pea-bean mosaic can apparently persist at a considerably higher temperature.

NELSON (R.). **Transference of the Bean mosaic virus by Macrosiphum solanifolii.**—*Science*, N.S. lvi, pp. 342-344, 1922.

The author describes a series of observations and experiments which are regarded as definitely proving that *Macrosiphum solanifolii* is concerned in the transmission of mosaic disease of beans (*Phaseolus vulgaris*). This is stated to be the first experimental proof of the transmission of this mosaic by insects. The varieties affected were Long White, Golden Wax, Brittle Wax, and Green Pod Stringless.

MELIN (E.). **Untersuchungen über die Larix-Mykorrhiza. I. Synthese der Mykorrhiza in Reinkultur.** [Investigations of the *Larix* mycorrhiza. I. Synthesis of the mycorrhiza in pure culture.]—*Svensk Bot. Tidskr.*, xvi, 2, pp. 161-195, 13 figs., 1922.

This is a full account of the author's successful syntheses of certain coniferous mycorrhiza, especially that of *Larix europaea*, of which a preliminary statement has already been noticed [see this *Review*, i, p. 442].

A description is given of the characters of larch mycorrhiza and

the constant association of *Boletus elegans* with the larch is noted. The methods of growing both symbionts in pure culture are described at length and a full account is given of the effects of bringing together the fungus and larch roots in pure cultures. The mycorrhiza thus formed by synthesis resembled the natural mycorrhiza, and enabled the author to study the different stages of mycorrhiza formation in some detail.

In similar attempts to synthesize larch mycorrhiza, using as the fungus symbiont *Mycelium radicis sylvestris* α, β, and γ [see this *Review*, i, p. 122], only those with the β form gave typical mycorrhiza, which, however, differed from those formed with *B. elegans* in certain morphological characters. The α and γ forms appeared to act in a more parasitic manner than *B. elegans*, the γ form producing no true mycorrhiza. *M. r. abietis* formed no mycorrhiza on the larch, which it attacked parasitically.

Boletus elegans was next tried on *Pinus sylvestris* and *Picea abies* without effect, and the author concludes that the association of this fungus with the larch is of an obligate nature. The relationship is believed to be one of mutual symbiosis, each giving support of some sort to the other.

Direct attempts to isolate the fungus from naturally formed larch mycorrhiza failed, and even those produced synthetically gave no fungous growth when the usual methods of isolation were tried.

McLUCKIE (J.). **Studies in symbiosis. I. The mycorrhiza of Dipodium punctatum R. Br.**—*Proc. Linn. Soc. New South Wales*, xlvii, 3, pp. 293–310, 26 figs., 1922.

The cortex of the root of *Dipodium punctatum*, a holosaprophytic orchid growing in the humus under Eucalypts in New South Wales, contains an endophytic fungus which forms close coils in the cells, especially in the vicinity of the nucleus. The fungus occurs in the soil surrounding the root in the form of numerous, branching, fine hyphae, many of which form a close tangle on the surface of the root. From this tangle, hyphae penetrate the cortex through the passage cells of the exodermis, branching freely and infecting numerous cells within the exodermis, but not entering the raphide cells or the meristematic zone of the root. In newly-infected cells the hyphae are very slender, but they increase in thickness after they have been within the cell for some time, and become filled with dense, deeply staining, granular protoplasm with few vacuoles. No vesicles are formed. The starch grains gradually disappear from the cells after infection. In certain cells occupied by the fungus for some time, the highly nourished hyphae begin to disorganize, losing their individuality and forming a deeply staining mass in the centre of the hyphal tangle. The nucleus of the infected cell at the same time increases to twice or three times its normal size, the nucleolus also enlarging. The chromatin stains more deeply and appears more abundant, the whole condition being suggestive of a high state of nutrition. The final appearance of the fungus is an irregular mass of indefinite structure, but apparently composed largely of proteids. Small droplets of a yellowish, highly refractive substance were in some cases present in the host cells at this stage. The gradual destruction of the fungus appears to

be the result of its digestion by the cytoplasm of the host cells. The latter process is particularly marked immediately before and during the development of the flowering shoot, when an extra supply of proteid is evidently necessary. After digestion the cytoplasm of the host cells appears quite normal, and starch reappears during the process, though in smaller quantities than before.

The penetration of the hyphae from cell to cell, and from the soil into the root, is probably the result of a chemotropic stimulus due to the presence in the host cells of a nutritive substance, probably sugar. The greater concentration of this substance round the nucleus would explain the growth of the hyphae in that direction. The protoplasm or proteid of the fungal hyphae increases at the expense of the starch which disappears from the infected host-cells; hence the carbohydrates of the latter appear to be used in the synthesis of nitrogenous food in the mycelium, which at this stage must be regarded as parasitic. The nitrogen for this process is probably derived from the soil through the hyphae connecting the endophytic mycelium with that on the surface of the root. In the next stage the substance of the fungus is taken up by the host plant by a process of digestion.

In *Dipodium* the higher plant appears to derive most benefit from the association. The fungal hyphae forming the mycorrhiza are indispensable to the host, which is devoid of chlorophyll, and therefore incapable of photosynthesis. Such starch as it contains is probably the result of the presence of the endophyte, which appears to be never exterminated, but to be always active in some part or other of the root. The higher plant is further without root-hairs and, therefore, dependent on the fungus for its supplies of water, ash constituents, carbonaceous substances, and nitrogen; in fact, it appears that all its requirements are supplied directly or indirectly by the fungus. Thus the higher plant may be regarded as being, on balance, parasitic upon the endophyte.

SUNDARARAMAN (S.). **The Coconut-bleeding disease.**—*Agric. Res. Inst. Pusa, Bull.* 127, 8 pp., 6 pl. (1 col.), 1922.

The first symptom of the coco-nut bleeding disease, which is widely distributed in the Madras Presidency, is the exudation of a reddish-brown fluid from cracks on the surface of the stem. This fluid turns black as it dries. The tissue below the bleeding portion is decayed and yellow, at first in localized patches, then extending and involving much of the interior of the stem. At an advanced stage of the disease, the crown dwindles and the palm ceases to bear nuts and finally dies. Young palms are the most severely affected, especially when the base is attacked. The inner, soft tissue rots, and a cavity is formed in the centre of the stem. Here a thin, yellowish fluid accumulates and gushes out when the cavity is incised. If the decay extends downwards the tree becomes hollowed out, no external symptoms of disease being visible. When this occurs the whole palm should be cut out and burnt as treatment is impossible. The disease is caused by a fungus, *Thielaviopsis paradoxa*, a brief historical and descriptive account of which is given. Inoculations with mycelium from glucose agar cultures were carried out on seedling plants grown in pots. The results indicated that

the fungus infects the stem through a wound or crack, and also that it cannot attack uninjured leaves or petioles.

The most effective remedy in cases of localized infection is to excise the diseased parts, together with about an inch of the surrounding healthy tissue. This operation should be followed by the drying of the cut surface with fire, and the application of hot tar to the wound. This treatment has proved very successful in a case under the writer's observation, in which one hundred trees were completely cured. It is important to remember that the external symptoms do not always indicate the extent of the internal decay, the latter often being found at a considerable distance from the parts visibly affected on the exterior of the stem.

GARNER (W. W.), MCMURTREY (J. E.), & MOSS (E. G.). **Sand drown, a chlorosis of Tobacco and other plants resulting from magnesium deficiency.**—*Science*, N.S., lvi, pp. 341-342, 1922.

Investigations have been carried out by the Bureau of Plant Industry, in co-operation with the North Carolina Department of Agriculture, on a chlorosis of tobacco popularly known as 'sand drown'. The disease, which occurs in an aggravated form on sandy fields after heavy rainfall, has been found to be due to an insufficient supply of magnesium in the soil or fertilizer. The ratio between the quantities of sulphur (sulphate) and magnesium contained in the fertilizer is also important, the symptoms of magnesium deficiency being intensified by an increase in the quantity of sulphur applied to the soil.

The chlorosis usually begins at the tip and along the outer margins of the older leaves, advancing towards the leaf base and extending progressively to the upper leaves of the plant. Sometimes, however, large areas of the leaf surface may already be involved when the symptoms first become noticeable. The veins and midrib of the leaf tend to retain their normal colour, but there is more or less complete blanching of the lamina, both yellow and green chlorophyll pigments being affected. In this respect, and in the more gradual death of the affected tissues, 'sand drown' differs from the chlorosis due to potassium deficiency. Sandy and sandy loam soils appear to be chiefly affected, especially where the rainfall is abundant.

The addition of sulphate or chloride of magnesium to the fertilizer has always resulted in the control of the disease. Comparative tests indicated that low grade sulphates and chlorides of potassium containing large quantities of magnesium, such as kainit and 'double manure salt', prevent this chlorosis, while high grade sulphates and chlorides of potassium intensify it. Dolomitic limestone also prevents it, while comparatively pure calcite is ineffective. Cotton seed meal, tobacco stalks and stems, and organic manures also tend to reduce 'sand drown', as they all contain appreciable quantities of magnesium, while other common sources of nitrogen which are deficient in magnesium, e.g. nitrate of soda, dried blood, and ammonium sulphate, favour its development. In pot cultures this type of chlorosis is readily induced by omitting magnesium from the nutrient solution, and may be cured by adding magnesium, at any rate in the early stages. The constant addition of sulphur

to the soil from rain water during rainy seasons, and the corresponding loss of magnesium by leaching, explain the greater prevalence of the disease under such conditions.

Experiments have shown that maize is also liable to 'sand drown', which probably affects a wide range of crops in light, sandy soils. Probably less than 50 lb. of magnesium per acre would suffice to remedy the deficiency. These investigations indicate the necessity for taking magnesium into account both in the general problem of liming and in the composition of so-called complete fertilizers.

NOBÉCOURT (P.). **Sur le mécanisme de l'action parasitaire du Penicillium glaucum Link et du Mucor stolonifer Ehrb.** [On the mechanism of the parasitic action of *Penicillium glaucum* Link and *Mucor stolonifer* Ehrb.]—*Comptes Rendus Acad. des Sciences*, clxxiv, 26, pp. 1720–1722, 1922.

The author's experiments, a short description of which is given, indicate that the destructive action of *Penicillium glaucum* and *Mucor stolonifer* on fruits is due to enzymes secreted by these fungi. The juice expressed from fruits rotted by them was found to have a pronounced cytolytic and plasmolytic action on thick slabs of different fruits, pieces of carrot, Jerusalem artichoke, onion bulbs, broad bean stalks, &c., immersed in it. By heating at about 60° C. for 15 minutes the juice loses this destructive power, which is furthermore temporarily inhibited at temperatures near the freezing point. The active substances can be extracted from the juice by strong alcohol, and water solutions of the precipitate thus obtained act in the same way as the juice itself. These enzymes, which the author calls 'fungal toxins', only act in an acid medium; after adding bicarbonate of soda to the active juice, the latter can no longer destroy plant tissues immersed in it. An attempt to obtain the toxins from carrot broth in which both fungi were cultivated was unsuccessful, even though there was an abundant growth of mycelium in the medium, but the liquid obtained by macerating the mycelium of *M. stolonifer* for a few days in distilled water possessed the power of disorganizing plant tissue. The toxins secreted both by *P. glaucum* and *M. stolonifer* disorganize tissues of plants which the fungi themselves cannot attack; the author concludes therefore that the immunity of such plants is not due to the resistance of their tissues to the substances secreted by the fungi, but to some other causes which he is trying to determine.

WILLAMAN (J. J.) & DAVISON (F. R.). **Biochemistry of plant diseases. IV. Proximate analysis of Plums rotted by Sclerotinia cinerea.**—*Botan. Gaz.*, lxxiv, 1, pp. 104–109, 2 figs., 1922.

Proximate analyses of several resistant and non-resistant varieties of plums rotted by *Sclerotinia cinerea* showed that the rotted tissue consistently contained a higher percentage of ash, calcium oxide, nitrogen, and ether extract than the tissue of sound plums; the authors believe this to be probably due to a loss of dry matter through respiration, which previous work has shown to be higher in infected than in sound plums. Crude fibre contents were found to be markedly higher in the resistant than in the susceptible

varieties, while the percentage of all other constituents was lower in the former, but not sufficiently so to limit the nutrition of the invading organism. It appears quite probable that the quality and quantity of cellulose material are important factors in resistance. It was noted that as the ripening of the plums proceeded, there was a decrease in the ash, nitrogen, and calcium content, due probably to storage of carbohydrates and acids.

YOUNG (H. C.) & BENNETT (C. W.). **Growth of some parasitic fungi in synthetic culture media.**—*Amer. Journ. of Bot.*, ix, 8, pp. 459–469, 4 text figs., 1922.

The authors have carried out an investigation of the importance of the various elements in synthetic culture media for fungi, and the best concentrations in which to use them.

A review of previous work on the food requirements of fungi is given, together with formulae by Raulin, Mayer, Pfeffer, Richards, Currie, Uschinsky, Czapek, and Coons. In general all the solutions yet devised depend upon whether the investigator considered the presence or absence of the inorganic constituents important for the growth of the fungus, and do not appear to have been founded on accurate study. The rôles of calcium, iron, and zinc seem to have especially caused discussion. Molisch considered calcium unnecessary for normal growth, and although this fact is based on little experimental data it has been generally accepted. Currie concluded that iron has no effect on *Aspergillus niger*. Others, however, have found both iron and calcium beneficial although not essential. Steinburg has more recently shown that zinc has a very decided stimulative effect.

In determining the rôle of the so-called essential inorganic elements along with that of calcium and zinc, Richards' solution (potassium nitrate 1 gm., potassium acid phosphate (monobasic) 0·5 gm., magnesium sulphate 0·25 gm., ferric chloride a trace, saccharose 3·43 gm., and water 100 c.c. Reaction P_H 4·2) was used as a standard and as a basis for the deviations, the inorganic constituents being replaced by non-essentials and the sucrose by different sugars. The possible importance of impurities was recognized and only selected glass and specially prepared chemicals were used. Cultures of *Fusarium oxysporum*, *Aspergillus niger*, and *Rhizopus nigricans* were made in flasks containing the various solutions and the dry weight of mycelium taken after sixteen days. The results indicate that calcium exerts a stimulative action on growth, and although the exact manner in which this is effected is problematical the rôle of calcium in counteracting acidity probably plays an important part in the process. To make sure that the increased weight was due to fungous growth and not to calcium oxalate, the mycelium was treated with alcohol and 30 per cent. hydrochloric acid. Zinc sulphate stimulated the growth of *A. niger* but not of *F. oxysporum* or *R. nigricans*. The quantity of acid produced by *A. niger* and *R. nigricans* is proportional to the amount of fungous material produced; with available carbon growth continues until stopped by hydrogen-ion concentration. The acidity of the culture solution in which *F. oxysporum* was grown increased to a maximum of P_H 3·6 and then diminished,

alkalinity developing until all the organic compounds were broken up and a P_H value of 8·4 was reached.

A further experiment on the effect of calcium and zinc on the growth of eighteen parasitic organisms showed that calcium is generally beneficial, though in the case of four organisms it retarded growth. *Rhizoctonia solani* grew only when calcium was present. *Fusarium radicicola* was pink in solutions containing calcium and colourless in potassium solutions. Zinc sulphate gave slightly beneficial effects with only two organisms.

It would seem that the salt requirements for an optimum synthetic solution should contain nitrogen, phosphorus, sulphur, potassium, calcium, and magnesium. There is no evidence of the correct proportions in which these inorganic elements should be used, but since the salt requirements for fungi are probably the same as for higher plants, two triplicate series of twenty-one cultures were made on the method used by the National Research Council [United States] for work in the study of the nutrition of higher plants. Potassium acid phosphate (monobasic), calcium nitrate, and magnesium sulphate were used in one series. The salts varied in the different solutions by increments of one-eighth and had an osmotic concentration of 3·5 atmospheres. Sucrose was added in equal amounts of 3·43 gm. per 100 c.c. of the solution, thereby giving the culture solutions a total osmotic pressure of 4·5 atmospheres. Potassium nitrate, calcium acid phosphate, and magnesium sulphate were similarly used in the other series. *Fusarium oxysporum*, *Macrosporium sarcinaeforme*, and *Phoma upiicola* were the fungi used, and dry weights were determined after sixteen days incubation. The results of this experiment show clearly that a proper balance of the inorganic constituents in the solution is essential for maximum growth, and that this balance can be readily obtained by the use of the triangular system of the National Research Council. By this system the mineral requirements of any particular fungus can be quickly and accurately ascertained, and by selecting the sugar most readily used, a favourable culture solution can be made.

Pole Evans (I. B. & Mary). **Rise in temperature of living plant tissue when infected by a parasitic fungus.**—*Nature*, cx, 2762, pp. 480–481, 1922.

In investigating the effects of inoculating oranges and grapefruit with *Penicillium digitatum* the authors found that a very definite rise of temperature took place in the infected living tissues, while the temperature was not observed to rise when the host tissue was killed prior to inoculation. To what extent direct reaction of the host is responsible for this rise of temperature is still to be determined, and also whether the phenomenon is a general one, occurring in all cases of attack by parasitic fungi on living plant tissue.

Testing of new varieties of the Potato for immunity from wart disease.—*Scottish Journ. of Agric.*, v, 3, pp. 306–311, 1922.

New potato varieties sent in for trial are tested for immunity from wart disease during at least two years at the Philipstoun station of the Scottish Board of Agriculture, as a susceptible variety

might conceivably escape detection in a dry season unfavourable for the development of the disease. A certificate of immunity is given to the varieties which satisfactorily stand the test. In the second year of trial the varieties are grouped together in the field according to certain standard characteristics of the tubers and haulms, of which the colour of the sprouts grown in diffuse light and the date of maturity of the tubers form the two main bases of classification; both features are fairly constant and the latter is of the greatest importance to the growers.

The tests completed in 1921 comprised 130 varieties, including some eighty from the United States and twenty-two from Germany; in addition, a large number of single tubers and seedlings were submitted for a preliminary test. Among the American varieties, only four of the Up-to-Date type were of outstanding merit and these were non-immune from wart disease; eighteen named sorts and three seedlings proved to be immune. These eighteen named varieties comprise only ten types as follows:—Irish Cobbler (4), Early Harvest, Ehnola, Perfect Peachblow, Early Manistee, Green Mountain (6), Netted Gem, Keeper, Northern King, and McCormick. It is noted that Irish Cobbler and Keeper are indistinguishable from the British varieties America and Sutton's Flourball respectively; these sorts were first put on the market in the United States and the stocks have been subsequently sent over to England. The non-immune varieties included representatives of the Rural New York, Early Rose, and Beauty of Hebron types, and also of the British Up-to-Date type. Of the German varieties tested only four proved to be immune, while none appeared to be as good as the British standard types.

A very large and representative collection of British varieties, immune and non-immune, was sent to the United States in 1920. According to the report of 1921 the following sorts proved to be free from leaf-roll, mosaic, streak, and diseases of unknown origin: Ally, May Queen, Great Scot, Rector, Climax, Provost, and Duchess, while the varieties Epicure, Dargill Early, Majestic, and Rhoderick Dhu had only 5 per cent. of their numbers affected. The amount of disease in Tinwald Perfection, Golden Wonder, Resistant Snowdrop, Eclipse, Langworthy, Arran Victory, Irish Queen, Templar, King Edward, Lochar, Witchhill, Mauve Queen, Bishop, and Immune Ashleaf was over 50 per cent. Of a similar consignment sent to Germany, many were destroyed by frost and only Great Scot was regarded with favour.

Wart disease of Potatoes: immunity trials.—*Gard. Chron.*, lxxii, p. 229, 1922.

The results of the tests for immunity from wart disease demonstrated on 28th September 1922, by the Scottish Board of Agriculture at Philipstoun, West Lothian, showed that selfed immune varieties of potatoes produced a large number of immune seedlings. In many respects the latter reproduced their parents' characteristics; some, such as those from Ally, Abundance, and Templar, were indistinguishable from the parents and showed a high percentage of immune individuals. The result of crossing an immune and a susceptible variety (Flourball × President), showed about 40 per cent. of immune

ndividuals after two years, whereas the crossing of two immunes Majestic x Flourball) gave 70 to 80 per cent. of immunity. Seedings of Up-to-Date x Majestic also showed a fair proportion of mmune types.

WAKSMAN (S. A.). **The influence of soil reaction upon the growth of Actinomycetes causing Potato scab.**—*Soil Science*, xiv, 1, pp. 61–79, 1922.

The results of a series of experiments showed that the limiting cid reaction for the growth of *Actinomyces scabies* in culture solu-ions, properly buffered, and in sterile soil, varies with the strain. The determinations of the growth in liquid cultures were made by iltering off and weighing the fungus, and in soil cultures by neasuring the production of ammonia. In some of the soil series he amount of *Actinomyces* was determined by plating and counting he colonies.

In the majority of cases, the limiting acid reaction is about P_H 5·0 to 5·2; some strains even grow at P_H 4·8, while others begin o develop only at P_H 5·3 to 5·6. These results, in the main, bear ut those of Gillespie (*Phytopath.*, viii, 6, p. 257; *Soil Science*, iv, 4. . 313; and v, 3, p. 219). The optimum hydrogen-ion concentration n the soil cultures was found to be from P_H 5·8 to 7·7, while the imit on the alkaline side was P_H 8·8. The alkaline limit is there-ore too high for arable cultivation, but the acid limit will allow good crops of potatoes to be grown. The saprophytic soil *Actino-nyces* appear to be more acid resistant than the strains of *A. scabies*. By the use of the proper amount of sulphur inoculated vith *Thiobacillus thiooxidans*, an acid reaction can be obtained vhich will control common potato scab. This is equivalent to making the soil acid by means of sulphuric acid, since the sulphur s oxidized to H_2SO_4 by the action of the bacillus. In soils that are dready of an acid nature, the use of green manures may suffice to ontrol scab owing to the formation of organic acids during their lecomposition.

It is admitted that the term *Actinomyces scabies* includes a group of pathogenic forms, but the various strains examined by the writer ppear to be covered by the limitations given above.

ENNISON (H. M.). **Potato blackleg, with special reference to the etiological agent.**—Abs. in *Phytopath.*, xii, 9, p. 444, 1922.

Continuing his investigations of *Bacillus atrosepticus* van Hall see this *Review*, 1, p. 82], the author presents the index-number 5312–32120–2110 in lieu of a fuller (revised) description of this organism. The bacillus develops acid and gas in the presence of a number of saccharides. Gas production is weak nitially, but is capable of intensification by cultivation in sugars vhich the organism can utilize. It secretes invertase, lactase, and naltase, and quantitative determinations showed that it cannot ydrolyse potato starch or dextrin.

RICHARDS (B. L.). **Corticium vagum as a factor in Potato production.**—Abs. in *Phytopath.*, xii, 9, p. 444, 1922.

In a series of pure culture experiments, several strains of *C.*

vagum were found to produce severe and characteristic cankers on all underground parts of the potato, young plants being attacked most vigorously, and growing points being especially susceptible.

In extensive field experiments the fungus, under favourable conditions, seriously reduced the number and size of the tubers, decreased the number of stems per hill, and greatly weakened the surviving ones which were usually undersized and died early. Yields from 500 diseased hills and 500 disease-free hills, grown under comparable conditions, showed that inoculation of the soil with the *Rhizoctonia* stage of *C. vagum* reduced the crop to 50 per cent. of that obtained from treated seed. Under natural conditions, soil temperature proved to be the most important factor in determining the loss.

RAEDER (J. M.) & HUNGERFORD (C. W.). **The effect of presprinkling with water upon the efficiency of certain Potato seed treatments for the control of Rhizoctonia.**—Abs. in *Phytopath.*, xii, 9, p. 447, 1922.

Preliminary laboratory tests have shown that disinfective treatments for seed potatoes are rendered more efficient by presprinkling with water. Potatoes sprinkled and covered for 24 hours, then treated with formaldehyde (1 in 120) at 50° C. for 3 minutes or 55° C. for 1 minute, or covered for 48 hours and treated with formaldehyde (1 in 120) at 50° C. for 2 minutes, gave clean seed, but cultures from seed similarly treated, except that they were not presprinkled, showed that the control was not absolute.

Sprinkling with water and covering 24 to 48 hours before treatment with mercuric chloride was advantageous, but in no case was the control absolute.

MIÈGE (E.). **Sur une maladie de la Pomme de terre observée au Maroc.** [On a Potato disease observed in Morocco.]—*Bull. Soc. Path. Vég. de France,* ix, 2, pp. 109–112, 1922.

The author believes that a disease of potatoes observed by him at Rabat (Morocco) in 1921 has not previously been described. Although a bacterial origin is suspected, his inoculation experiments so far have given inconclusive results.

The symptoms visible on the aerial portion of the plant are very characteristic. The progress of the disease is plainly basipetal. It begins at the extremity of the branches, usually those at the top or middle of the plant. The terminal leaflet after being covered with brown patches resembling burns, blackens and dries up rapidly and completely; the petiole is immediately afterwards attacked at its upper extremity and soon dries up, the diseased portion being at first sharply defined from the lower part, which remains green and healthy. The disease spreads progressively and pretty rapidly over the whole of the branch, working toward the main stem and destroying all the leaflets on the way. In a few days the whole of the branch first attacked is completely withered and blackened and other branches become involved. The main stems are invaded and covered with elongated, blackish spots which originate from contact with a diseased branch. The tubers are sometimes infected before maturity, but they may show no symptoms whatever at harvest

ime, and only become outwardly diseased some days or even weeks fter lifting. The disease is easily recognized on the surface of the uber by the presence of blackish-purple dots, at first rare, later nore and more numerous. Subsequently the zone underlying these lots takes on a blackish-brown hue, which spreads progressively. inally, the affected parts undergo a soft rot from which, under ressure, a fairly clear liquid exudes; the whole tuber rots rapidly, nd is rendered useless. Even where the symptoms are not visible n tubers just dug up, the number and size of the latter are requently reduced, even more so than is the case with *Phytophthora*.

The trouble occurred again in the autumn crop, planted on the 4th October. At the beginning of December the varieties Italie Blanche, Early Rose, and especially Saucisse and Mayette Hâtive, vere suffering from a rather mild attack, while Italie Rouge, Ricce, La Quarantaine, and Express remained more or less immune.

The damage done by this disease is considerable, most of the arieties cultivated in Morocco being affected in varying degree hroughout the growing season.

BENNETT (J. P.) & BARTHOLOMEW (E. T.). **Respiration of Potatoes in relation to the occurrence of blackheart in storage.**—Abs. in *Phytopath.*, xii, 9, p. 443, 1922.

The work of earlier investigators indicated that blackheart was lue to a disturbance of respirational processes dependent on a tem- erature-time-oxygen relationship. This relationship appears to e fairly definite. From 40° down to 5° C. the period of exposure equired to induce blackheart increased from 8 to 77 days. Below 5° C. blackheart did not occur until the oxygen was practically xhausted; with increase of temperature above 30° C. an increasing mount of oxygen remained when blackheart appeared. Injury eading to the development of blackheart appears to be due to naerobic processes. At temperatures where oxygen exhaustion recedes blackheart, the injury may appear in any part of the tuber; t higher temperatures it usually occurs centrally.

BAUMANN (E.). **Enkele opmerkingen omtrent de Lampongsche Peperziekte.** [Some observations on the Lampong Pepper disease.]—*Teysmannia*, xxxiii, 7–8, pp. 289–293, 1 pl., 1922.

Although the premature death of pepper vines [*Piper nigrum*], which has long been known as a serious disease in Sumatra and West Java, is, according to Rutgers' observations (*Meded. Inst. voor Plantenziekten* 18, 19, and 27), closely connected with defective or unsuitable cultivation, cases have also occurred of the sudden decline of apparently healthy vines in well cared for plantations. The present paper deals with the writer's preliminary investigations of the latter form of the disease. The material studied was from an experimental plantation of the Phytopathological Institute at Buitenzorg, started in 1915. It had received the most careful attention, but by 1920 a number of vines had begun to die off, and the disease has now attained serious dimensions.

The death of the vines was preceded by certain well-defined symptoms. Transverse sections of branches which were already losing their leaves revealed a brownish discoloration of a part or

the whole of the vascular bundles. Microscopic examination showed that most of the discoloured vascular bundles were dead and filled with a brown, gummy exudation. Hyphae or bacteria were not present, but the dead vessels or adjacent cells sometimes contained a granular deposit along the cell walls. This discoloration was found almost from the top to the bottom of the branches, and extended to the veins of the leaves. The nearer the top of the branch or the tip of the leaf, the weaker was the discoloration until a point was reached when it disappeared. Sections through the zone just beyond the point of visible discoloration revealed masses of bacteria in many of the vascular bundles and adjacent cells, more than one-third of the xylem being invaded. The author's observations indicated that the premature death of the vines was always accompanied by discoloration, vines from which the discoloration was absent not tending to succumb before their time.

Experiments were conducted to ascertain whether the bacteria were concerned in the causation of the disease. Young plants raised from seed, and also young healthy vines, were inoculated with cultures of the bacteria obtained from the vascular bundles, while others were inoculated for control purposes with a common saprophytic bacterium. After a week the vascular bundles of the former group of plants exhibited the typical discoloration to a height of 10 cm., those of the latter showing only a general discoloration of the inoculation canal. At the end of about ten weeks, two of the young plants and three of the vines, inoculated with the material from the diseased vascular bundles, shed their leaves and died. The results of these tests prove that the premature death of pepper vines, preceded by discoloration of the vascular bundles, is due to bacteria, the systematic position, life-history, distribution, and control of which require further elucidation.

The following tentative explanation is advanced for the diseased condition of pepper vines found in the affected areas of the Dutch East Indies. In addition to the continuous decay of the plants in neglected plantations, which is directly due to malnutrition, there is a bacterial disease which probably attacks only the vascular bundles. This disease, like the corresponding one of bananas [see this *Review*, i, p. 223], may long remain latent, the decisive factor in its activity being neglect of cultivation. The specific agent of the disease, however, is a bacterium, or group of bacteria, parasitic in the vascular bundles, the conditions of cultivation, &c., being only contributory factors. Care must be taken not to use the discoloured vines as cuttings for planting out as they will presumably transmit the disease, and the possibility of growing the plants from seed should be considered.

LEE (H. A.) & MEDALLA (M. G.). **The season's experiments on Fiji disease, mosaic disease, and smut of Sugar-cane.**— *Philipp. Agric. Rev.*, xiv, 4, pp. 402–412, 8 pl., 1922.

Field experiments carried out at Canlubang in 1921 on Fiji disease, mosaic disease, and smut gave the following results. The germination of setts from canes affected with Fiji disease was much lower than that of setts from healthy stools, and those that did germinate gave diseased plants in any type of soil. None of

these diseased plants yielded any cane whatever, while many died at a very early age. The spread of infection from diseased to healthy plants was very low (3·46 per cent.). Thus the losses from Fiji disease may be largely attributed to the use of tops and setts from infected stools.

The germination of setts from stools affected with mosaic disease was slightly lower than that of setts from healthy canes, and, as already found in Java, Hawaii, and Porto Rico, they usually transmitted the disease, often to 100 per cent. of the resulting plants, irrespective of the type of soil. Under Canlubang conditions the spread of the disease from affected to healthy plants appears to be very restricted, but further experiments will be necessary to determine the exact importance of insect and other methods of aerial transmission. A small proportion of the plants may outgrow the disease to such an extent that the leaf symptoms are no longer visible.

The germination of setts from stools of the susceptible Uba cane affected with smut [*Ustilago sacchari*] was distinctly poorer than that of cuttings from healthy canes, and the disease was transmitted in a large proportion of cases. There was no yield of cane from affected cuttings. The spread of the disease to healthy stools was very slight (0·75 per cent.) in the six months during which the experiment lasted. Setts from healthy cane soaked in the same receptacle as smutted cuttings showed 8·38 per cent. of infection in the same time.

The results of all these trials indicate that the use of healthy cuttings for planting is essential if the plantations are to be maintained free from disease.

LEE (H. A.), WELLES (C. G.), & MEDALLA (M. G.). **Fiji disease of Sugar-cane in the Philippines.**—*Philipp. Agric. Rev.*, xiv, 4, pp. 413–417, 3 pl., 1922.

Fiji disease, which is now fairly widely distributed in the Philippines and rapidly spreading from north to south, appears to have been introduced on cane cuttings from Australia or some of the other countries affected. Its presence in the Philippines was first detected in 1919.

The symptoms of the disease [see this *Review*, i, pp. 187 and 269] are described and illustrated by excellent photographs. It is stated that entire loss of the crop has been observed, but that it is usually restricted to 10 to 25 per cent. of the plants. Badilla cane appears to be the least susceptible variety, and it is in other respects a better cane than the Negros Purple variety now generally planted in Negros.

RICHARDS (B. L.). **Relation of rainfall to the late blight or Phoma rot of the Sugar Beet.**—Abs. in *Phytopath.*, xii, 9, p. 443, 1922.

During 1921 a late blight of sugar beet became epidemic in northern Utah and southern Idaho and caused severe damage, the intensity of the attack varying from a fraction of 1 per cent. to the total destruction of the crop.

The available evidence indicates that the trouble is possibly identical with the *Phoma* root rot of Edson and European workers.

The experience of 1917 to 1919 showed that such epidemics are favoured by drought which, especially during June, appears to create a dangerous period in the life of the beet. During certain years, as in 1921, an early drought reduces the vitality of the beets so much that they fail to recover and later succumb to late blight and root rot.

ESSIG (F. M.). **The morphology, development, and economic aspects of Schizophyllum commune Fries.**—*Univ. of California Publ. in Bot.*, vii, 14, pp. 447–498, 11 pl., 1922.

The author is of opinion that most of the damage to living trees attributed to *Schizophyllum commune* is really the work of other, more slowly growing fungi, such as *Polystictus versicolor*: no evidence was found that the first-named species is able to infect healthy trees or that it can grow on living wood except under very favourable conditions. His inoculations were made on wounded branches of young apple, pear, and plum trees. A detailed account of the morphology and development of the sporophore is given.

ZELLER (S. M.). **Morphological differences between Nectria galligena Bres. and N. coccinea (ditissima).**—Abs. in *Phytopath.*, xii, 9, p. 442, 1922.

Nectria galligena, described by Bresadola as the organism causing European apple and pear canker, is distinct from *N. coccinea* Fries (*N. ditissima* Tul.), to which the disease had been attributed previously. These two species differ morphologically and physiologically. Perithecia of *N. coccinea* from Oregon have walls composed entirely of pseudoparenchyma which stretches up to the ostiole, whilst in those of *N. galligena* from the same district the pseudoparenchyma extends only three-fourths the distance from the base, the remainder being composed of long, narrow cells which radiate from the ostiole, forming a cone. In size and colour of perithecia the two species are similar. Ascospores of *N. galligena* are 14 to 22 μ in length, those of *N. coccinea* 8 to 14 μ. Conidia of the former (*Fusarium willkommii*) are borne on creamy-white stromata and average 65·9 by 4 to 5 μ, those of the latter (*Fusarium* sp.) on orange-coloured stromata and measure 54 by 6 μ. Also the conidia of *N. coccinea* have more rounded ends and a curvature of shorter radius than those of *N. galligena*.

HUBERT (E. E.). **A staining method for hyphae of wood-inhabiting fungi.**—*Phytopath.*, xii, 9, pp. 440–441, 1922.

This is a rapid method for staining fungous hyphae in wood. The directions are essentially as follows. Cut sections from $\frac{3}{8}$ inch cubes of infected wood after boiling them in water for half an hour or more and soaking in glycerine alcohol (50 parts glycerine, 50 parts 70 per cent. alcohol) for one to two minutes. Wash with distilled water. Stain from two to five minutes with dilute methyl violet (4 parts of a saturated aqueous solution of methyl violet with 12 parts of distilled water), or in some cases full strength methyl violet for one to two minutes. Wash with distilled water, examine, and if the violet colour is faint repeat the methyl violet staining, or if the counterstain is faint stain again from the begin-

ning. Dry slowly on a warming plate, using a cover glass to keep the sections flat, as dehydration with alcohol apparently removes the violet stain. If sections curl, use egg albumen or gum arabic fixative. Add xylol and mount in balsam.

The method has been employed in the routine examination of woods for the determination of decay, and so far has given satisfactory results.

POOLE (R. F.). **A new fruit rot of Tomatoes.**—*Botan. Gaz.*, lxxiv, 2, pp. 210–214, 1 pl., 1922.

During the summer of 1921 a fungous rot due to *Oospora lactis* was observed on fruit of several tomato varieties in New Jersey. Both green and ripe fruits showed cracks in the surface, apparently due to some physiological cause, and the fungous growth appeared in the open cracks of the ripe fruit. The fungus caused a soft rot which affected the whole fruit in from two to five days. *O. lactis*, which occurs commonly in milk products, cheeses, decaying vegetables, &c., forms a dense, greyish-white, prominent, fluffy mycelium on the cracked tomato fruits, without any great production of spores. When the rotted internal tissues are incubated, the formation of abundant spore chains with little mycelium results. Inoculations from pure cultures rotted wounded ripe tomatoes readily, but had little effect on the unripe fruit. The optimum temperature for the development of the fungus is 18° to 20° C. A slight degree of control was secured by spraying with Bordeaux mixture, and also by dusting with a dust composed of 16 lb. anhydrous copper sulphate, 6 lb. lead arsenate, and 78 lb. hydrated lime.

CIFFERI (R.). **La 'carie' del Pomodoro.** ['Caries' of Tomato.]—*Le Staz. Sperim. Agrarie Italiane*, lv, 4–6, pp. 145–162, 1922.

Further experiments, carried out since the author's preliminary paper [see this *Review*, i, p. 363], confirm the pathogenicity of *Phoma ferrarisii* Cif., except that, normally, the fungus produces a dry rot, while the wet rot described in the first paper is due to the intervention of *Bacillus mesentericus*, acting, in the author's opinion, in symbiosis with the fungus. The bacterial action is apparently limited to the secretion of cytase, which disintegrates the binding substance between the cells without influencing the cells themselves. The fungus is believed to absorb the cellular contents by osmosis, thus killing the protoplasm, though it is possibly aided by the secretion of toxic enzymes.

A symbiotic relationship of this type is not known to the author to have been described in any other fruit rot. Parasitic action is reserved for the *Phoma*, while the saprophytic *B. mesentericus* works exclusively in favour of the fungus by removing the mechanical obstacles to its growth presented by the cell walls. This condition is termed by the author 'unilateral parasitic symbiosis', and it is thought that a similar phenomenon may explain certain wet and dry rots of potatoes associated with *Bacillus amylobacter*, *Fusarium solani*, and *Phytophthora infestans*.

Although conclusive proof cannot now be given owing to the accidental loss of evidential material, the results obtained with

parallel cultures of *P. ferrarisii* and the *Ramularia* referred to in the preliminary paper make it more than probable that the latter is a conidial stage of the former. It is named *Ramularia ferrarisii* n. sp. Extended Latin diagnoses for the two new species are now given.

Infection takes place solely through abrasions in the epidermis. Hailstorms and insect punctures undoubtedly help in the development of the disease, and non-parasitic troubles such as tomato 'split' ('screpolatura') are thought also to have some influence. Caries, though very destructive, has so far no great economic importance owing to its rare occurrence. The only remedial measure advocated is the immediate destruction of affected fruits.

ELLIOTT (J. A.) & CRAWFORD (R. F.). **The spread of Tomato wilt by infected seed.**—*Phytopath.*, xii, 9, pp. 428-434, 1 pl., 2 figs., 1922.

Although several authors have expressed the view that *Fusarium lycopersici* is transmitted through tomato seed, no one has fully established this fact. Seed was accordingly collected from wilted plants in September and October 1921, cleaned by fermentation and washing, then dried and placed in plugged flasks until 20th January 1922, when plating was commenced. Before plating the seeds were treated either with sterile water, or with mercuric chloride (1 in 1,000) for two minutes and then washed in sterile water, or with concentrated sulphuric acid, washed in water, and soaked for two minutes in mercuric chloride solution. Sterilized blotting-paper soaked in rice water was found useful in identifying *F. lycopersici*, as the fungus produced an alizarine pink to old rose coloration on this medium. Every fungus resembling the wilt organism was saved and tested by inoculation on tomatoes later. The number of isolations of *F. lycopersici* from 400 seeds treated with water only was 13, from 400 sublimated seeds 2, from 390 seeds treated with sulphuric acid and sublimate 4.

These results indicate that the organism is carried on the outside of the seed coat as a rule, but the isolation from seed treated with sulphuric acid and sublimate suggests that there is sometimes an internal infection. The strains isolated were tested on tomato seedlings and showed considerable difference in virulence, a result in accord with those previously reported.

SCHWARZ (MARIE B.). **Das Zweigsterben der Ulmen, Trauerweiden und Pfirsichbäume.** [The dying of twigs of Elms, Weeping Willows, and Peach trees.]—Thesis presented to the University of Utrecht, 73 pp., 7 pl., 15 figs., 1922.

DIE-BACK OF ELMS. This disease, which was first recorded in Holland in 1919 and became epidemic in 1920 [see this *Review*, i, p. 277, & ii, p. 1], is characterized by the sudden withering of the twig tips and the simultaneous death of the leaves. No lesions or fungous growth could be observed on the bark or leaves of dead twigs. Occasionally the latter were attacked by red mites, but the injury could not be ascribed to them as they were absent from a large proportion of diseased trees.

Transverse sections of diseased stems show the wood discoloured over a ring-like area of variable thickness. Such discoloration varies in intensity and extends into the limbs, trunk, and in the worst cases even to the extreme ramifications of the root system. From the fact that this discoloration was present in many trees showing no outward signs of disease, the author deduces that the disease existed in a latent stage for a few years before the outbreak of the epidemic. The discoloration is produced by an alteration of the walls of the vascular bundles. First the vessels are seen to be invaded by thin hyphae, against which tyloses are formed which later disappear. The walls of the vessels then become swollen and softened to a gum-like consistency, and fuse together. The other constituents of the wood assume a macerated appearance.

Cultures from dead twigs yielded different fungi, predominantly species of *Fusarium*. Cultures from fragments of the discoloured wood from inside the bigger limbs, however, always produced a fungus, which gave positive results from artificial inoculations, the wood being discoloured up to a distance as much as 30 cm. from the point of inoculation, although the other characteristic symptoms were not produced. The fungus produced a white fibrous *Cephalosporium*-like mycelium ('A' stage) on cherry agar, and under certain conditions yielded yeast-like spores ('B' stage). Later coremia appeared, consisting, when mature, of dark brown to black stalks, with light-coloured heads composed of an agglomeration of spores held together by mucilage. This stage agrees with the genus *Graphium*, and the author considers the fungus a new species which she has named *G. ulmi*, a full description being given of the various stages.

A few cases of primary infection were found on one year old shoots. The discoloration was seen to originate in the petioles and midribs, indicating that the leaves form the principal point of entry. The fungus is not, however, essentially a leaf parasite. Infections carried out on twigs showed that the fungus, after penetrating the leaf tissue, passes into the midrib, the petiole, and finally the stem. Leaf scars and wounds also allow its entrance. Introduced artificially into the wood, the mycelium spreads equally in all directions, whereas naturally it always progresses from above downwards and from the youngest wood to the older.

No difference in susceptibility was observed between *Ulmus campestris* L. and *U. campestris* f. *monumentalis* Rehd.

The disease is undoubtedly affected by weather conditions, but data are too meagre to warrant any exact deductions being made. As to control, the author does not recommend uprooting all infected trees, as a large proportion may recover by the growth of new wood over the discoloured ring. Curative treatment is not practicable, but the spread of infection into the main branches might be prevented by cutting out diseased twigs. Spraying immediately on the bursting of the leaf buds may be effective, but no trials have yet been made.

Die-back of Weeping Willow. The Dutch weeping willow, *Salix alba* var. *vitellina pendula* S., was heavily attacked in 1920 by the 'bark scorch' disease, a detailed description of the symptoms of which are given. The fungus *Fusicladium saliciperdum* was

preponderant and is, according to Rostrup and Tubeuf, responsible for the disease. The author, however, was unsuccessful in isolating it and did not carry out infection experiments.

A very considerable number of other fungi were usually present on portions of willow twigs killed by the *Fusicladium*; infection trials with pure cultures showed that some of them could be induced to parasitize living twigs. Especially common were *Aposphaeria pulviscula* Sacc. and numerous species of *Phoma*. One of the latter gave positive results from inoculation, and as it did not correspond with previously described species on *Salix*, the author named it *Phoma intricans*. A full description of this species is given. On a number of old *Fusicladium* bark lesions, *Physalospora salicis* occurred.

Dying of the shoots in autumn after defoliation was caused by *Discella carbonacea*. When the terminal bud is discoloured the tip of the twig soon dies back, always up to a node. The fructifications are at first covered by periderm through which, later, appear greyish-white to pink masses of spores. This fungus is known as one of the most frequent saprophytes of *Salix*, but the author's infection trials and observations showed that, after entering the host through wounds or dead parts, it can continue to develop vigorously as a parasite.

Die-back of Peach. Several fungi are concerned in the die-back of peach shoots which is very common in Holland. Only *Monilia cinerea*, however, is a true parasite. In 1921 this fungus did little damage to the peaches, probably on account of the hot, dry weather.

At the beginning of the winter, peaches which had suffered from mildew were found dying back at their shoots. Such shoots were covered with *Cladosporium herbarum* and, to a small extent, *M. cinerea* was also present. In a neglected glass house, *C. herbarum* alone was found, causing bark lesions on one or two year old shoots. At first the lesions were wet and brown; later they dried. They did not extend and the portion above did not die.

The author believes *Botrytis cinerea* to be responsible for a dying-back of peach shoots, especially in glass houses, as she found a number of dead shoots from which she could isolate no other organism. The twigs died back progressively, no distinct margin separating the dead portion from the healthy one. Such shoots were especially numerous after lice attacks.

On dead shoots, the author frequently found numerous large black pycnidia of *Cytospora prunorum* Sacc. & Syd. which forms brown, soft lesions on the twigs. These lesions at first are not distinguishable from those of *Monilia*, except that they are located at any point of the branches and not round the buds. Later, however, they dry and become grey in colour. A callus is formed round the scar, which may encircle the stem and kill the shoot above it. Three strains of *C. prunorum* were isolated, two of which gave positive results from inoculations while one did not. The latter sometimes infected weeping willows when inoculated into them, and the author considers it a different physiological strain from the other two.

DUFRÉNOY (J.). **Tumeurs de Sequoia sempervivens.** [Tumours on *Sequoia sempervivens.*]—*Bull. Soc. Path. Vég. de France*, ix, 2, pp. 148–150, 3 figs., 1922.

On trees of *Sequoia sempervivens* at St. Mandé and Vincennes, which had been pruned or otherwise wounded, the formation of tumours some distance from the wounds was observed, these growths being always absent on trees left intact. The tumours developed in the axils of the wounded branches and bore adventitious shoots covered with young leaves. Sections showed that the growths consisted of a parenchyma formed of giant cells in which were several cauline axes possessing each a well-developed pith and an irregular cambium. The wood was formed of reticulate elements, irregularly oriented and mixed with pitted cells. The polystelic structure was evidently the result of the coalescence of several proliferating adventitious buds, stimulated no doubt by bacterial infection through the wounds. Bacteria were observed in the parenchymatous cells of the tumours.

VINCENS (F.). **Maladies des jeunes plantes et champignons microscopiques nouveaux observés sur Cinchona en Indochine.** [Diseases of young plants and new microscopic fungi observed on Cinchona in Indo-China.]—*Bull. Soc. Path. Vég. de France*, ix, 2, pp. 125–133, 4 figs., 1922.

The author describes a disease, which he observed in 1920 in a plantation situated on the mountain of Honba, in Annam, on young plants of *Cinchona ledgeriana*, and, in a much lesser degree, of *C. succirubra*, as well as a hybrid between these two species. The affected plants, which varied in height between 15 to 20 cm. and 35 to 40 cm., were almost defoliated and seemed to be dying. The outbreak appeared to have become severe recently, judging by the slight signs on the older as compared with the younger leaves. The former had a few, small, circular, light brown spots, with a purple border, or were pierced with circular holes resulting from the falling out of the tissues within the border of such spots. On the younger leaves these spots were more numerous, and coalesced freely, forming chequered designs which covered the greater part of the leaf surface. The leaves nearer the top had shrivelled edges, eaten away in places, and were borne on deformed, crooked shoots on which were abnormal corky outgrowths often of a cankerous nature. On the hybrids the disease had the same characters, though the shoots seemed in a more healthy condition. On *C. succirubra*, which was decidedly more vigorous than *C. ledgeriana*, badly affected leaves were rare, and the shoots were all healthy. It is noteworthy that not a single plant seemed to be entirely free from the disease.

No parasitic organism was observed on leaves still attached to the stems, but small, black dots were visible on the spots on leaves that had fallen off some days previously. Similar dots were found on the wrinkled twigs of dying plants near the ground.

The following fungi found on the three species of *Cinchona* are described and figured. On the dead spots on the leaves *Phyllosticta honbaensis* n. sp. (rarely on *C. ledgeriana*, chiefly on *C. succirubra*) and *P. cinchonaecola* n. sp. were found, while *P. yersini* n. sp.

occurred on the lower surface of young leaves still enclosing the bud (and on the browned shoot bearing them) of a dying plant. In the suberized bark at the base of the latter plant numerous fruit bodies of a *Phlyctaena—P. cinchonae* n. sp.—were found, and the same fungus was obtained from nearly all the plants examined. A *Phoma—P. cinchonae* n. sp.—was present, but less frequently, in the same situation, while a *Dendrophoma—D. cinchonae* n. sp.—was observed on the leaf scars of a diseased plant left in a damp place after its collection. Partly buried in the wrinkled bark of the stem base of this same plant were found perithecia of a *Physalospora—P. cinchonae* n. sp. Finally, a *Guignardia—G. yersini* n. sp.—appeared occasionally on the bark harbouring the *Phlyctaena*.

No inoculation experiments were possible, hence the author is unable to say what share, if any, each fungus has in the production of the disease. He states, however, that the parasitism of the species of *Phyllosticta* does not appear to be in doubt, while the frequency of the *Phlyctaena* in the abnormal corky bark of diseased young plants stamps it also as a parasite. Spraying with copper solutions had a disastrous effect on the plants, and the practice had to be abandoned. Subsequent sowings of *C. ledgeriana* on a different plateau gave healthy plants.

Moss (E. H.). **Observations on two Poplar cankers in Ontario.**—*Phytopath.*, xii, 9, pp. 425–427, 1922.

The first part of this paper deals with the poplar canker caused by *Dothichiza populea* Sacc. and Briard. This disease, which was first reported in America in 1916, was very prevalent at Toronto in 1921 on 500 young Lombardy poplars planted the previous year, 90 per cent. of the trees being girdled by the fungus. The girdled area was usually located about two feet from the tip of the stem and extended for a considerable distance; numerous pycnidia occurred on the diseased parts and spore horns appeared as early as 4th May.

Later the disease was seen very frequently in southern Ontario, young shoots from the roots of old trees being killed back and pustules appearing on the stems. Usually several branches were affected, the older ones being disfigured by elongated, open wounds. In Ontario the disease has undoubtedly been present many years, but the writer's observations support the view that it was brought to America from Europe.

The second part of the paper refers to the canker disease of poplar caused by *Cytosporina chrysosperma* (Pers.) Fr., which occurs at various places in the United States, and is now reported for Ontario, attacking usually *Populus deltoides*, but also *P. italica*, *P. balsamifera*, *P. alba*, and *Acer saccharinum*. Affected trees of *P. alba* and *P. italica* died branch by branch from the top downwards. Near Toronto, *P. deltoides* was found bearing pycnidia close to wounds in the younger branches and lower parts of the trunks; in the latter case the trees were rapidly killed. The poplars had apparently been injured by fire and then attacked by the fungus, a course of events noted by two workers previously.